

Trouble-shooting instructions : ALF-5010  
BOSCH system : ABS  
Make of vehicle : ALFA ROMEO  
Basic microcard : KFZ-00..

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SPECIAL FEATURES

This microcard contains trouble-shooting instructions, valid at the time of publication, for the following models:

ALFA ROMEO 164 10.1987 ->

- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gear with 90 teeth.
- \* Up to approx. year of manufacture 9.1988 adjust wheel-speed sensors on all wheels as required with shims.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 5 and term. 4.  
front right to term. 23 and term. 21.  
rear left to term. 7 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

**CAUTION !**

Do not drive with tester connected!  
The brake system must be bled of air before the  
ABS test. Do not activate the ABS tester while  
the system is being bled.  
Repeat the complete test program after any repairs  
are carried out.  
The Antiskid System is a vehicle safety  
system.  
Work on the system demands detailed knowledge  
of the system.  
The conventional brake system must be  
O.K.

### General information for trouble-shooting:

**Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.**

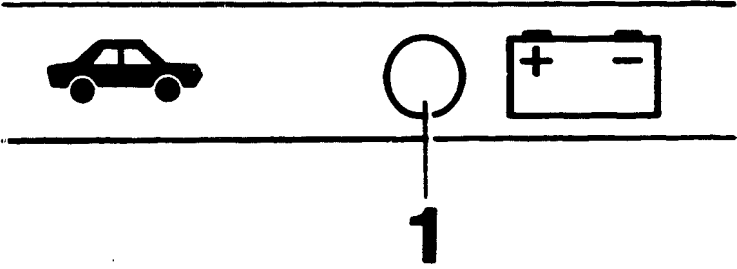


RAPID DIAGNOSIS CHART

Do not drive with tester connected! Have all test prerequisites been satisfied?

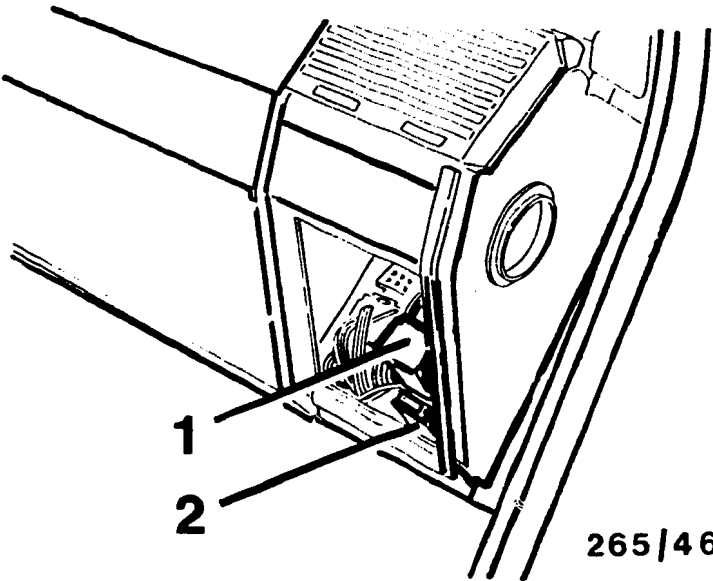
Program-selector-switch settings 1 - 6

Testing of (Measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (Term.1 and term.20)	Ignition on	LED 1 (top picture) lights up continuously	<ul style="list-style-type: none"><li>* Fuse defective.</li><li>* Inadequate battery charge.</li><li>* Excessive voltage dips.</li><li>* Test lead to driving switch, term. 15.</li><li>* Over-voltage protection relay defective.</li></ul>



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1 = Over-voltage protection relay  
2 = Fuse 10A

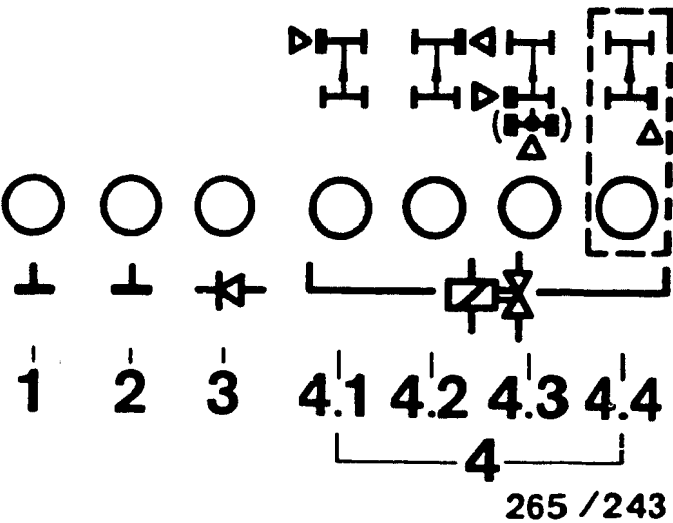


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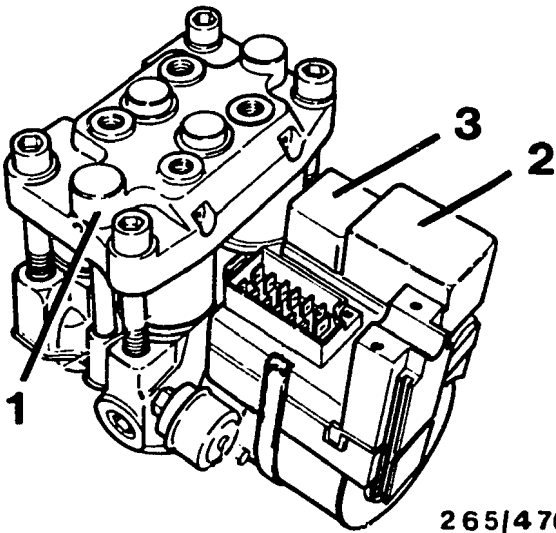
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<p>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</p> <p>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</p> <p>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.</p> <p>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></p> <p>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</p> <p>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</p> <p>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</p>



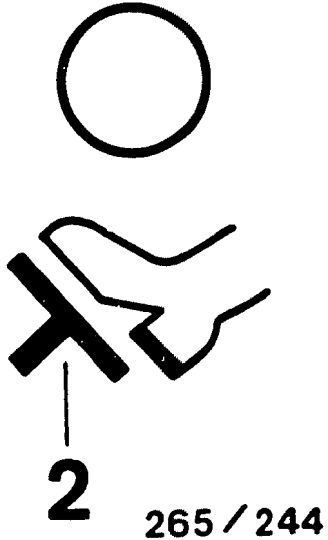
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



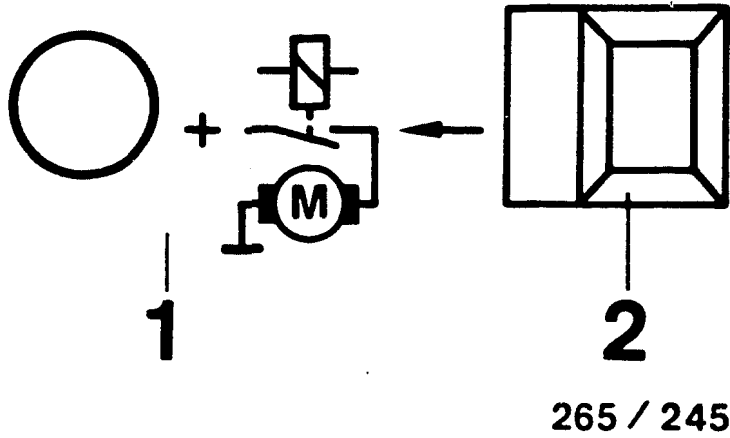
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RAPID DIAGNOSIS CHART (CONTINUED)

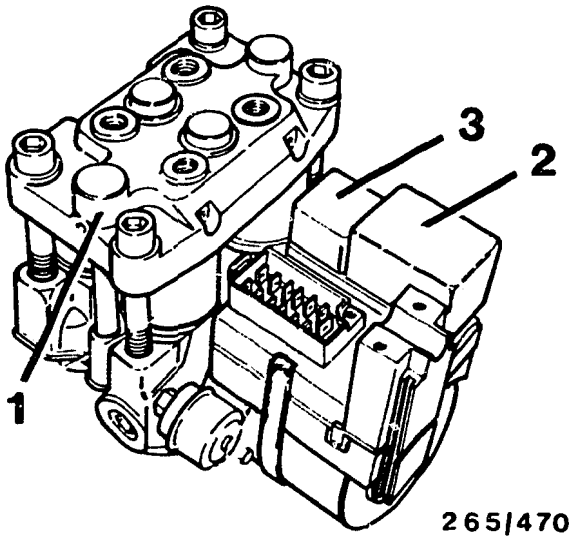
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 2.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>

Program-selector-switch position 4 not applicable.

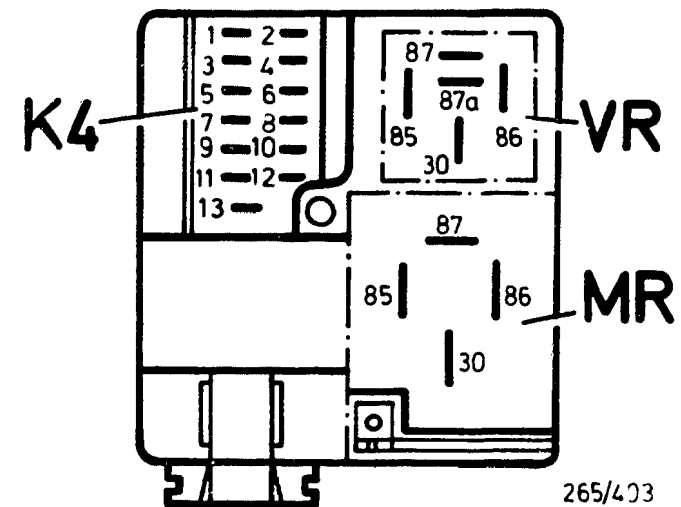
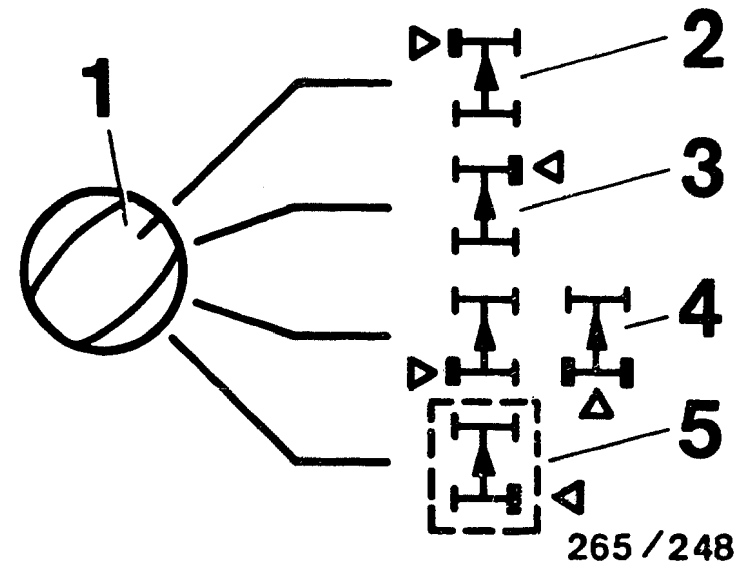
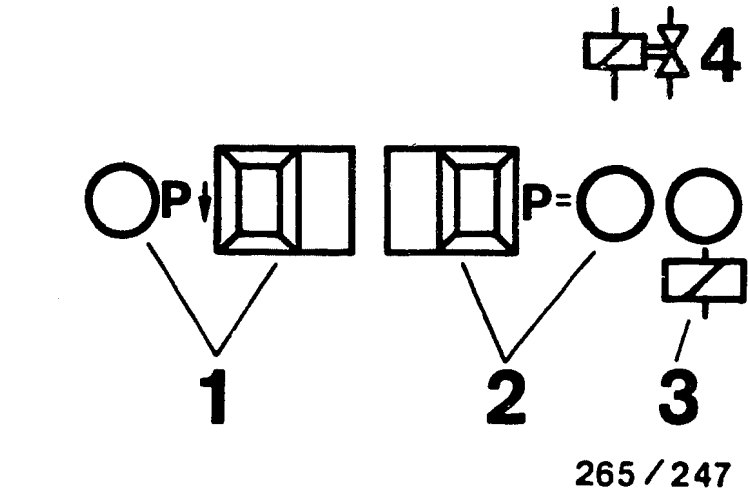


1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (4-channel hydraulic modulator)

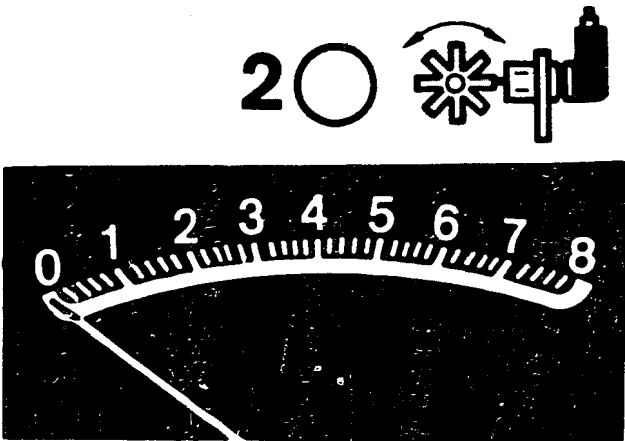
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydraulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+  * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration) lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration); battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.18 Wheel, rear right: term.19 Rear axle: term. -  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

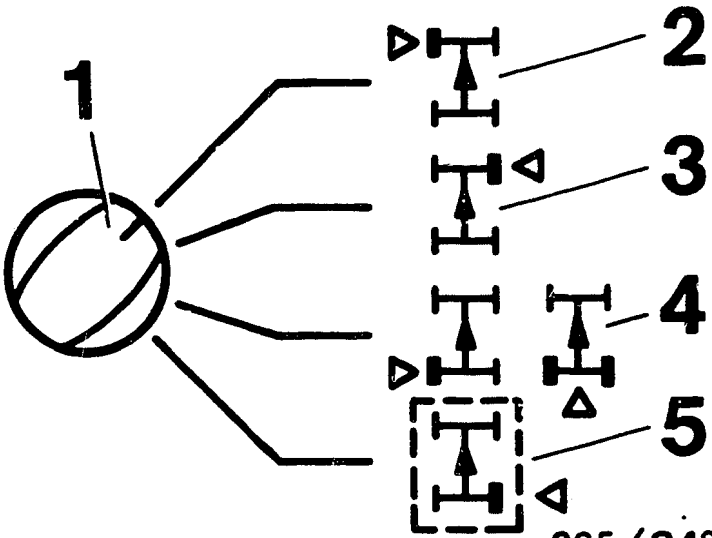
Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and t.5</p> <p>Wheel, front right: term.23 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,0 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 90 teeth Rear axle: 90 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



1

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## TEST SPECIFICATIONS

## Wheel-speed sensor

\* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:  
rear wheels:

600...1600 Ω  
600...1600 Ω

## Hydraulic-modulator solenoid valves

\* Winding resistance at ambient temperature ( $-10^{\circ}\text{C} \dots +120^{\circ}\text{C}$ ):

$$0,7 \dots 1,7 \quad \Omega$$

## Air gap between wheel-speed sensor and ring gear

```
* at front wheels:
* at rear wheels:
```

0,8 ±0,5 mm  
0,8 ±0,5 mm

### Tightening torque for

- \* fastening screws of wheel-speed sensors:

**> 8 Nm**

\* Brake-line connections at hydraulic modulator:

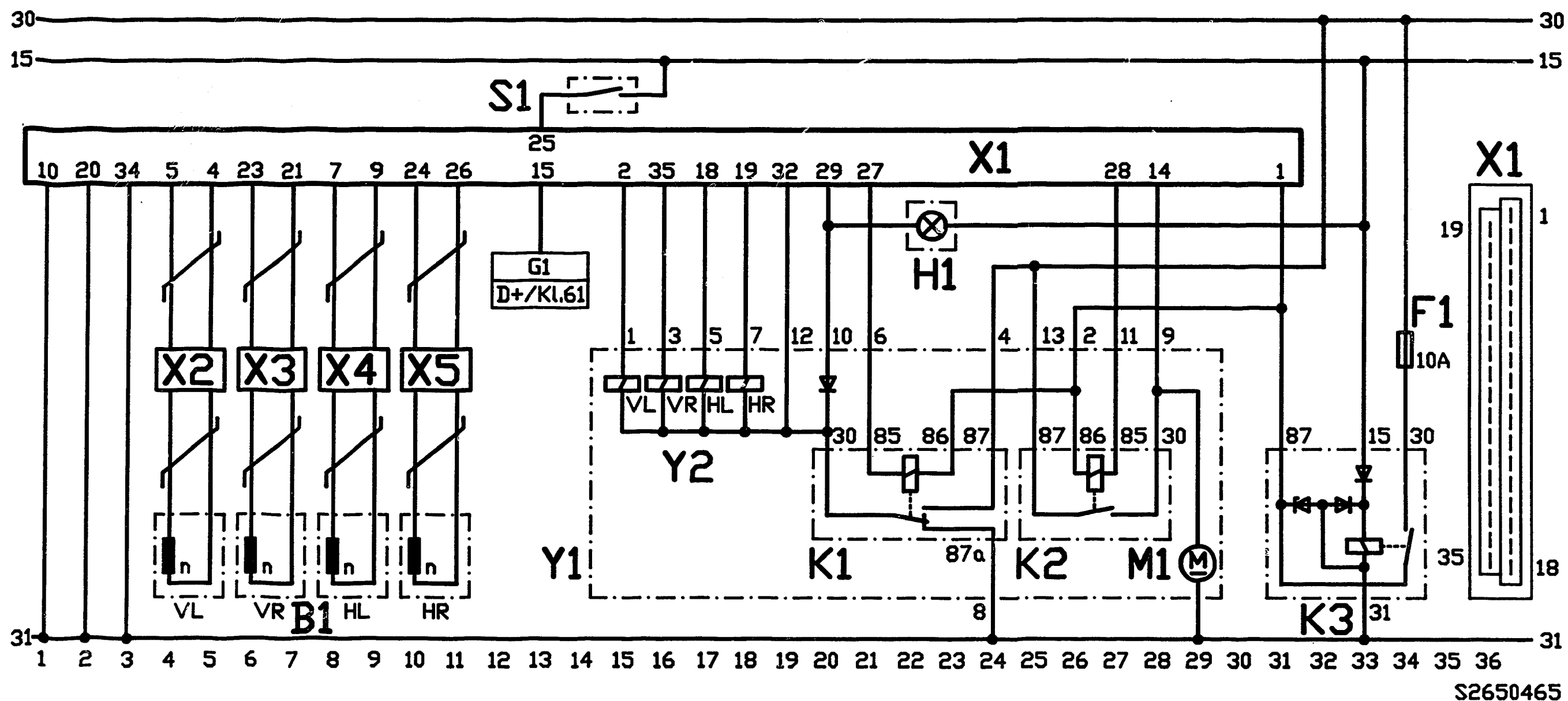
**12...16 Nm**

### Number of teeth on ring gears of wheel-speed sensors

```
* at front wheels:
* at rear wheels:
```

90 teeth  
90 teeth

For production reasons:  
continued on the following  
coordinate.



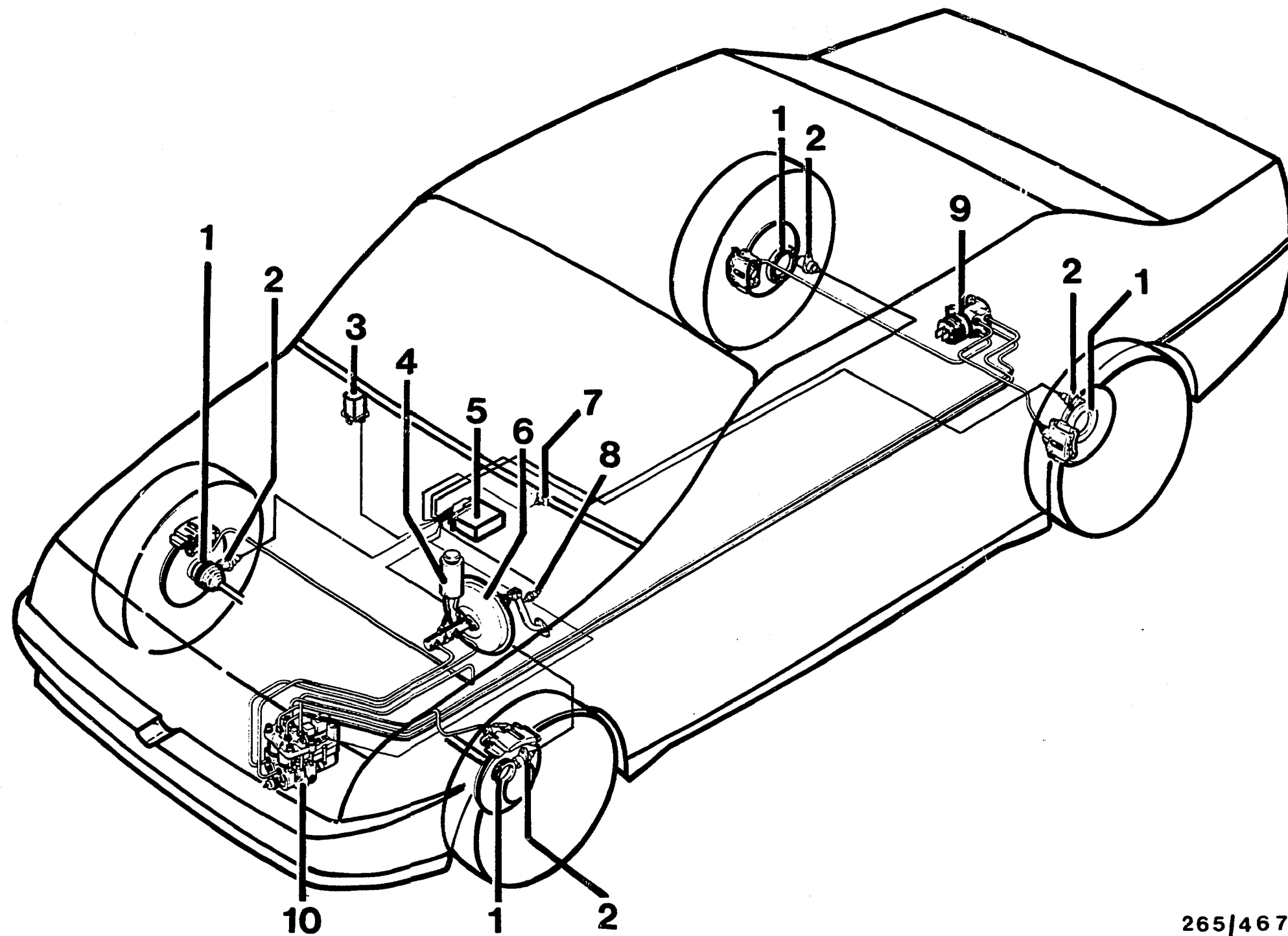
# ELECTRICAL TERMINAL DIAGRAM

B1 = Wheel-speed sensor  
 G1 = To alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Overvoltage-protection relay

M1 = Return-supply-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pin)  
 X2...X5 = Wheel-speed-sensor plug  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves

HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right



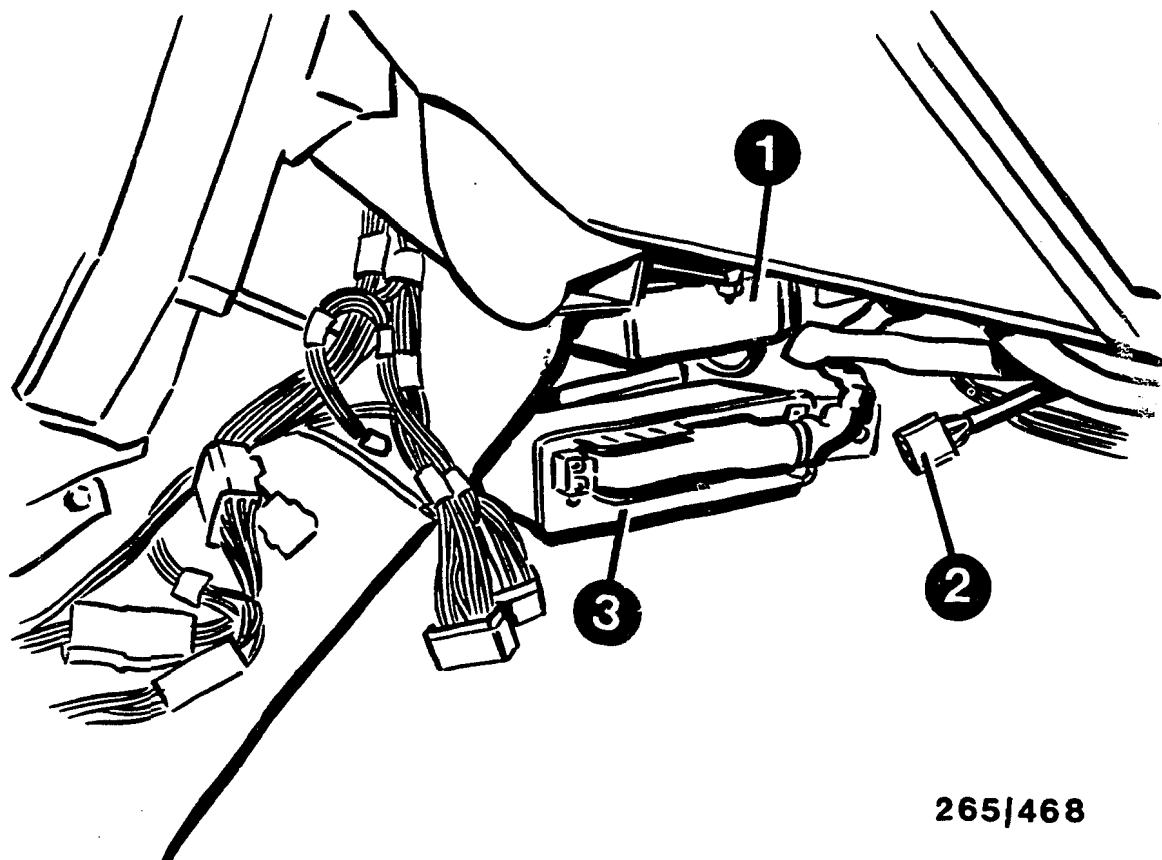


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# INSTALLATION POSITION OF COMPONENTS

1 = Ring gear  
 2 = Wheel-speed sensor  
 3 = Over-voltage protection relay  
 4 = Brake-fluid reservoir  
 5 = ABS controller

6 = Brake booster  
 7 = ABS warning lamp  
 8 = Stop-lamp switch  
 9 = Braking-force regulator  
 10 = ABS hydraulic modulator



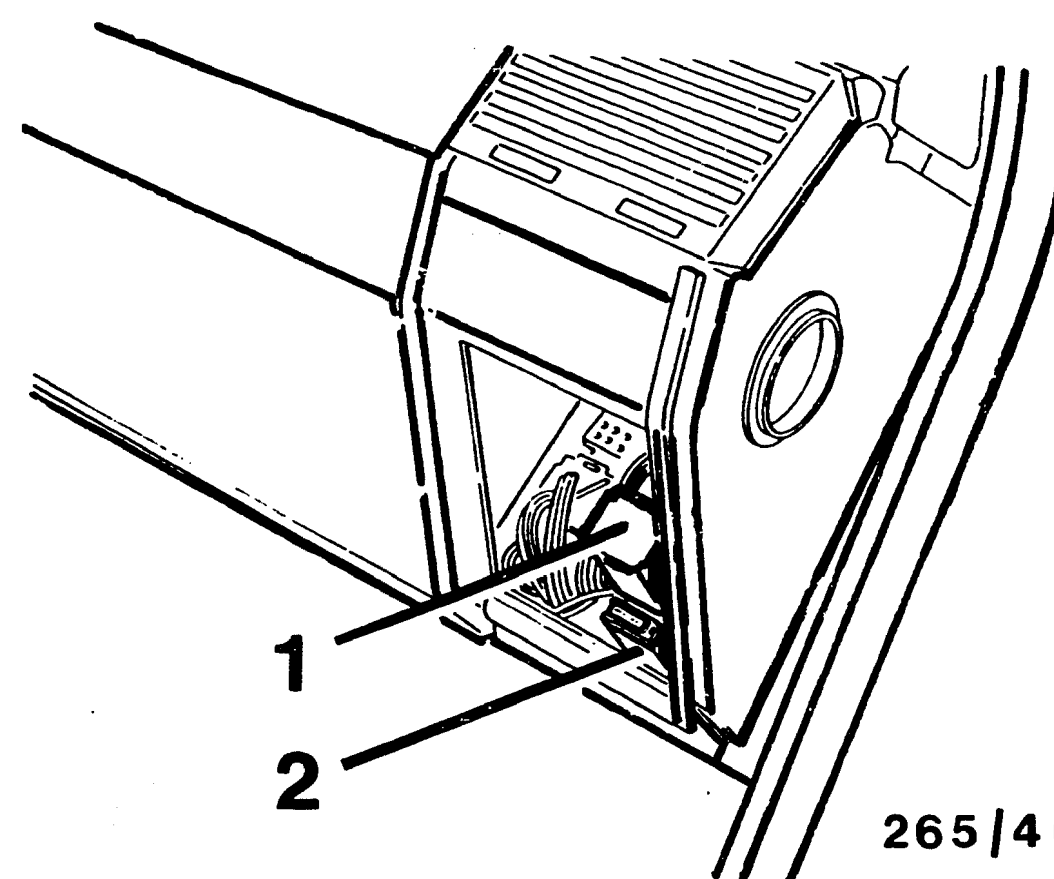
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- 1 = Motronic control unit
- 3 = ABS controller

#### INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

- \* Controller:  
In passenger-side footwell, on left, behind cover for center console.
- \* ABS warning lamp: in instrument panel.  
Symbol: skidding car.
- \* Stop-lamp switch:  
At brake pedal.
- \* Battery:  
On left-hand side of trunk beneath a cover.

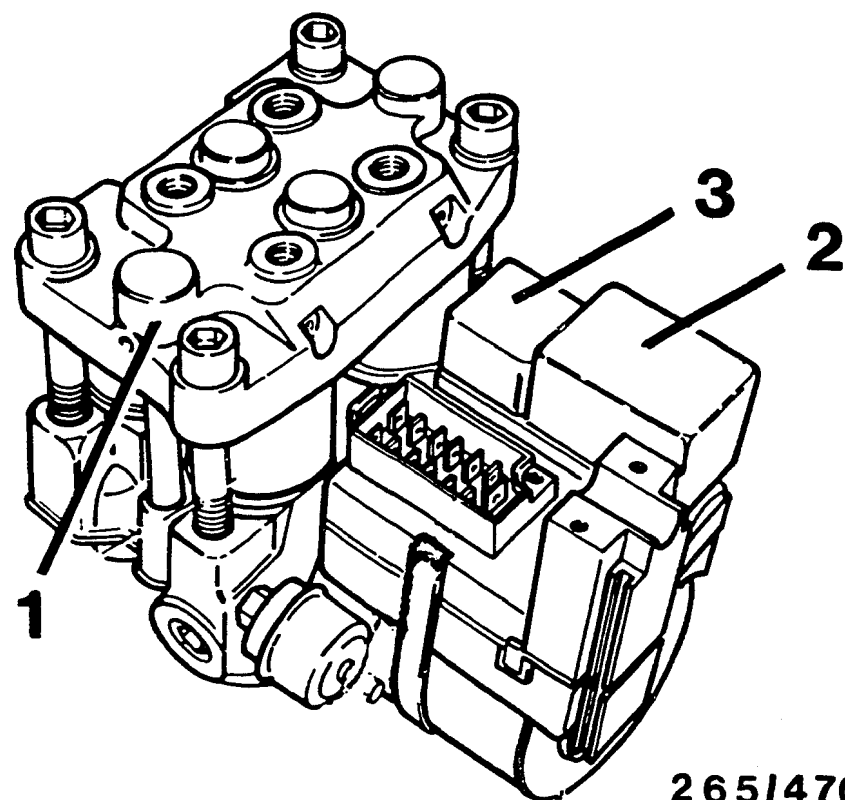


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- 1 = Over-voltage protection relay
- 2 = Fuse 10 A

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Over-voltage protection relay:  
In passenger compartment, to right of glove compartment, behind a cover.
- \* ABS ground terminals:  
At left-hand spring-strut dome and on left of engine.
- \* Positive terminal (term. 30):  
In engine compartment above the steering column beneath a plastic cover.



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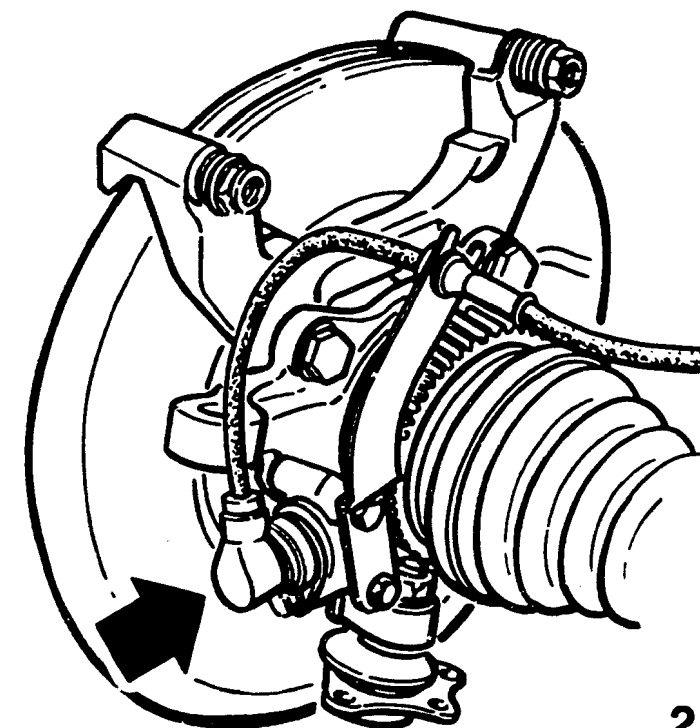
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Hydraulic modulator  
In front left of engine compartment on cross-member.

The hydraulic modulator cannot be repaired, but rather it is to be replaced in its entirety.  
Exception: changing relay.

Pay attention to correct assignment of brake-line connections.



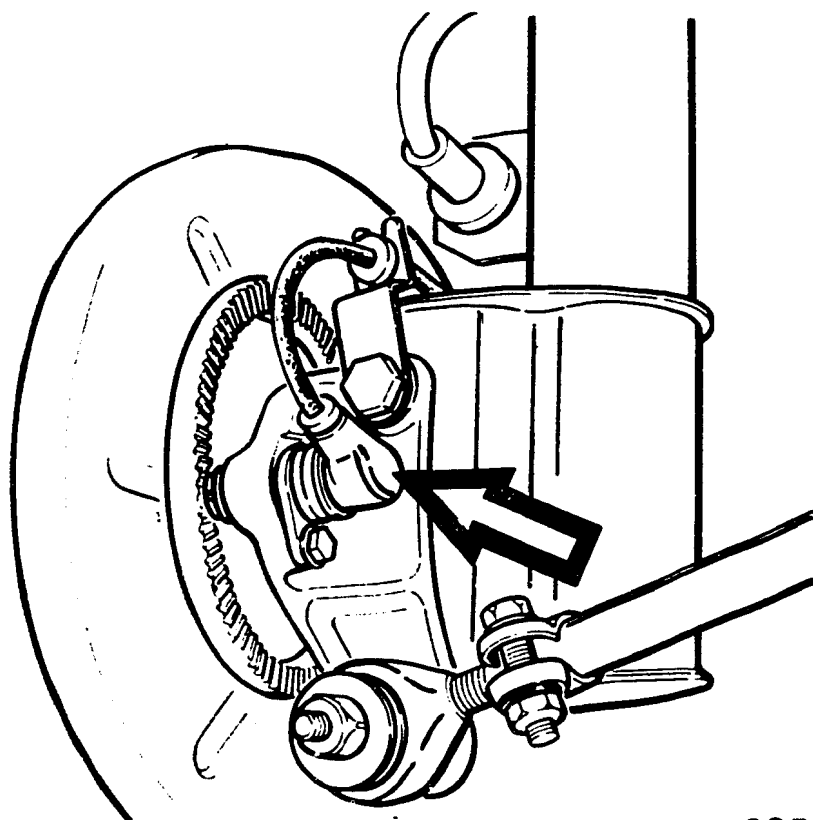
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Arrow = Front wheel-speed sensor

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Front-axle wheel-speed sensor:  
One each on left and right in steering knuckles.  
Take care not to lose existing shims. Check air gap and correct if necessary with corresponding shims.  
Adjustment using shims is no longer required as of the new axle design from approx. 9.88 onwards.

Wheel-speed-sensor plug connections:  
On spring-strut domes in engine compartment.



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Arrow = Rear wheel-speed sensor

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Rear-axle wheel speed sensor:  
One each on left and right at wheels.

Take care not to lose existing shims. Check air gap and correct if necessary with appropriate shims.  
Adjustment with shims is no longer necessary as of the new axle design from approx. 9.88 onwards.

Wheel-speed-sensor plug connections:  
On left and right in trunk in recesses beneath the side trim.

For production reasons:  
continued on the following  
coordinate.

Trouble-shooting instructions : ALL-5004

BOSCH system : ABS

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SPECIAL FEATURES

This microcard contains testing and repair instructions for defective ABS warning-lamp diodes.

- \* This affects all hydraulic modulators with a diode in the relay plug-in frame. The diode is used to actuate the ABS warning lamp.
- \* Hydraulic modulators with a defective diode in the relay plug-in frame need not be repaired.  
There are 3 repair solutions as regards the wiring harness:
  - 1.Installation of a replacement diode at the wiring-harness-end plug of the hydraulic modulator when the hydraulic-modulator plug is a blade terminal.
  - 2.Installation of a replacement diode in the ABS controller plug when the hydraulic-modulator plug is a pin terminal (e.g. Kostal plug with DB).
  - 3.Replacement of diode in plug connection of hydraulic modulator on Citroen and Rolls Royce.

**SAFETY AND PRECAUTIONARY MEASURES**

- \* The ABS is a safety system.  
Extreme care is to be taken when performing all work on ABS components and on the ABS wiring harness.  
If repair work is not carried out properly, brake failure may lead to accidents!
- \* Whenever repairs have been performed, a complete ABS test is to be carried out using the ABS2 LED tester.
- \* Make sure all connectors of wiring harness are properly attached.
- \* Never detach or connect ABS wiring-harness plug from controller with ignition switched on.

**TESTERS, TOOLS AND SERVICE PARTS**

Name	Designation	Part no.
Digital multimeter	e.g. MMD 301	0 684 500 301
Torx socket wrench for Citroen and RR	TX 15	
Diode	BYW 54 Valvo, AEG-Telefunken	8 905 405 432

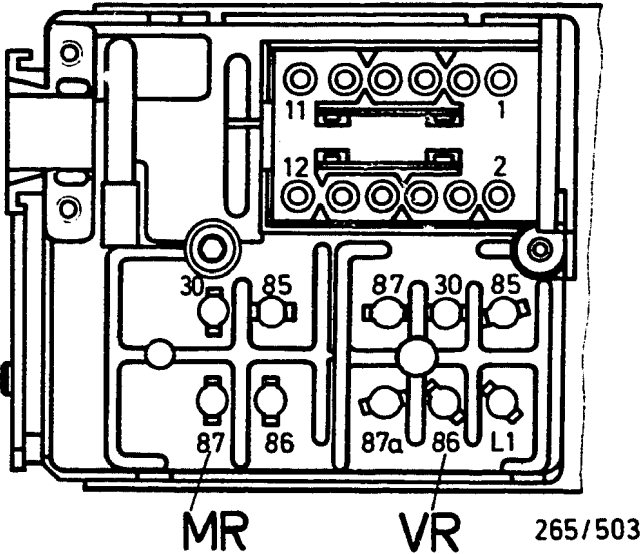
HYDRAULIC MODULATORS AFFECTED

Hydraulic modulators with diode in plug-in frame.

How is it possible to tell whether there is a diode fitted in the plug-in frame?

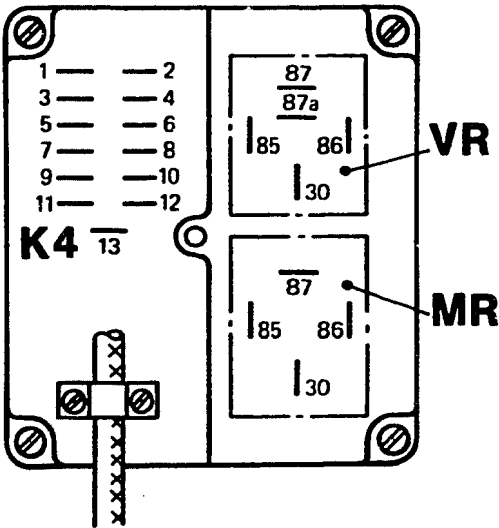
Switch off ignition.  
Remove hood from hydraulic modulator.  
Detach valve relay.  
(Removal information is given in vehicle-specific instructions).

If the plug-in frame has a terminal L 1 for the valve relay, then there is no diode fitted in the plug-in frame. (Diode in valve relay).  
If there is no terminal L 1, the diode is fitted in the plug-in frame.  
The 3-channel hydraulic modulators for Citroen and Rolls Royce are an exception. In these cases, the diode is fitted in the plug.



Hydraulic-modulator plug-in frame with term. L 1 (bottom right)  
MR = Motor relay  
VR = Valve relay

Hydraulic-modulator plug-in frame without term. L 1  
MR = Motor relay  
VR = Valve relay



## DIODE TEST

Before a replacement diode is fitted, the diode installed in the hydraulic modulator or in the plug (Citroen, Rolls Royce) is to be tested using a multimeter (e.g. MMD 301).

Switch off ignition.

Remove hood.

Detach plug from hydraulic modulator.

Attach test prods to terminals in plug-in frame/plug to which diode is connected.

The corresponding terminals are to be taken from the circuit diagram given in the vehicle-specific instructions. (Example DB: term. 4 and term. 7)

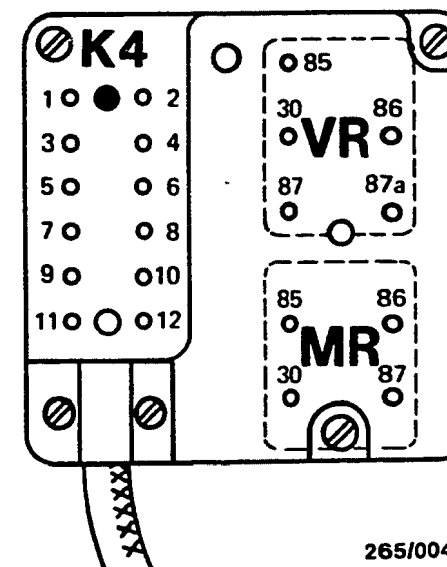
Measurement-mode selector in "diode" setting.

Set values for MMD 301

in forward direction: 500...800 mV

in reverse direction: approx. 1500 mV

Please refer to corresponding operating instructions for set values as regards other multimeters.



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3-channel hydraulic-modulator  
plug-in frame

MR = Motor relay

VR = Valve relay

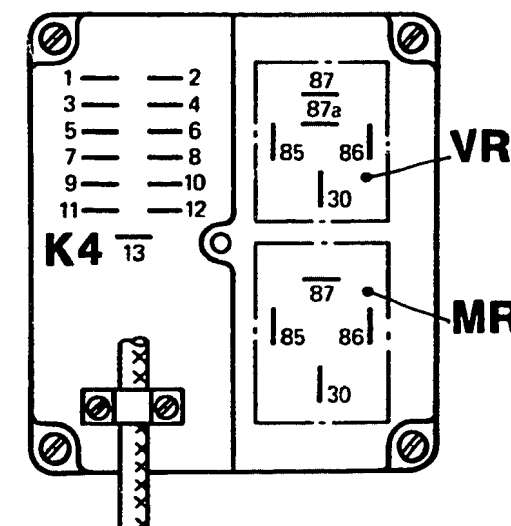
K4 = Wiring-harness plug

4-channel hydraulic-modulator  
plug-in frame

MR = Motor relay

VR = Valve relay

K4 = Wiring-harness plug



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## REPAIR SOLUTION 1:

In the case of hydraulic modulators with blade terminals a replacement diode can be fitted as follows:

Ignition off.

Remove hood. Loosen strain-relief clamp for ABS wiring harness and detach plug from hydraulic modulator.

Press back plug catch (top picture) and open up top part of plug (bottom picture).

Use vehicle-specific circuit diagram to determine the terminals to which the diode is connected.

Cut through the lead to the anode of the diode at the plug (e.g.

BMW 5 Series: term. 1).

Strip end of lead on wiring-harness end and solder anode of replacement diode (BYW 54) to it.

Note: The cathode of the diode is marked, e.g. with a ring.

Solder the cathode end of the diode to the lead of the other terminal (e.g. BMW 5 Series: term. 3). To do so, strip lead all-round for approx. 5 mm.

Carefully wind insulating tape around bright areas and diode, so as to avoid short-circuits.

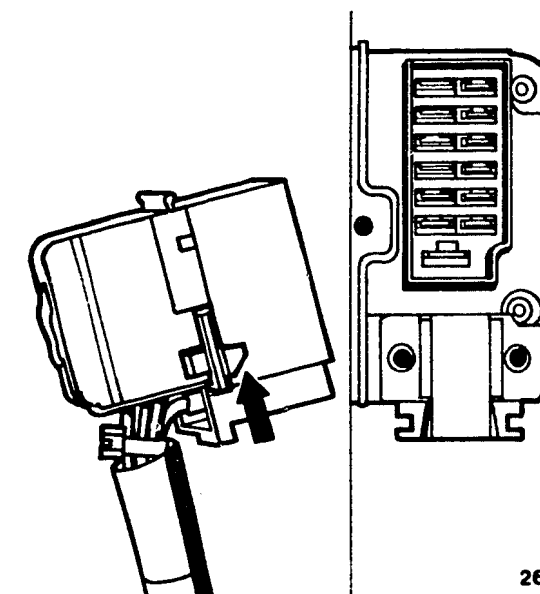
Close top part of plug, attach plug, screw on strain-relief clamp and fit hood.

Check whether warning lamp lights up with controller detached and ignition switched on.

Additionally connect ABS2 LED tester and perform a complete ABS test for safety reasons.

Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

Fill in test report for recording complaints linked to Bosch passenger-vehicle ABS systems and send it to Robert Bosch GmbH, K1/VAK, Robert-Bosch-Str.2 in 7141 Schwieberdingen, West Germany.



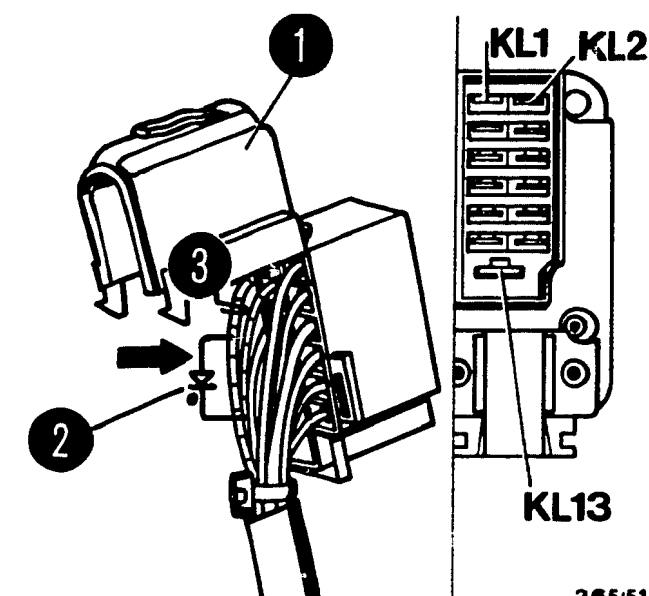
Arrow = Catch

Arrow = Anode end

1 = Opened plug

2 = Diode

3 = Cut through lead



## REPAIR SOLUTION 2:

In the case of hydraulic modulators with pin terminals, a replacement diode can be fitted as follows:

Ignition off.  
Detach plug from controller.

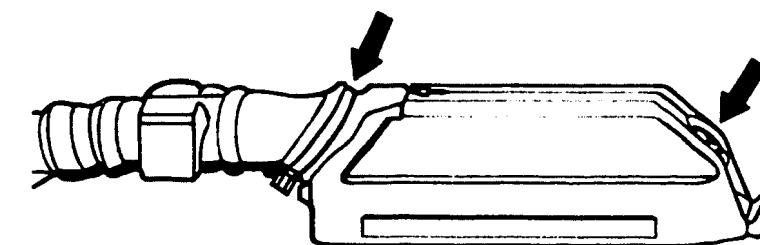
Open up 35-pole plug:

### \* Old plug design:

Remove cable strap and roll back sleeve or vice-versa depending on plug version. Loosen screw and pull out cap.  
Caution ! Fanning strips may drop out.

### \* New plug design:

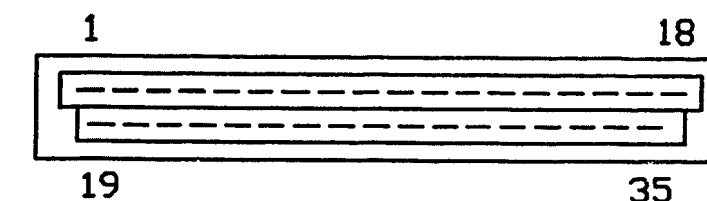
Loosen tie band and screw (top picture).  
Roll back rubber sleeve and unscrew strain-relief clamp.  
Remove rubber seal.  
Pull out plug insert with pliers.



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Arrows = Tie band and  
screw

Top view of 35-pole plug  
from controller



265/430

Strip leads to term. 29 and term. 32 approx. 5 mm (top picture).

Solder anode end of new diode (BYW 54) to lead to term. 29.  
Solder cathode end of diode to lead to term. 32.

Note: The cathode of the diode is marked, e.g. with a ring.

Carefully wind insulating tape around bright areas and diode.

Assemble plug. Do not forget rubber seal and tie band !

To avoid the possibility of any follow-up damage, cut through lead to anode end of built-in diode at plug of hydraulic modulator (bottom picture).

The corresponding terminal is to be taken from the vehicle-specific circuit diagram.

Wind insulating tape around free ends of lead.

Take care when opening plug at hydraulic modulator to ensure that no bushings fall out !

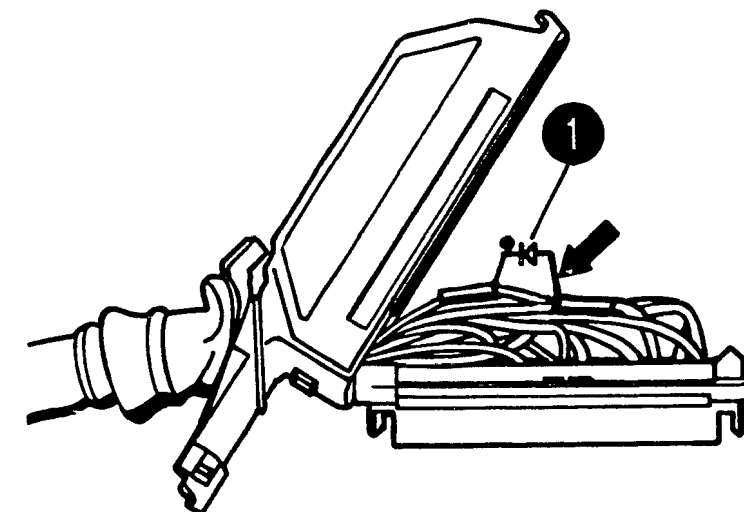
Mixing up leads can have catastrophic consequences for ABS control !

Check whether warning lamp lights up with controller detached and ignition switched on.

Additionally connect ABS2 LED tester and perform a complete test with the ABS2 LED tester for safety reasons.

Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

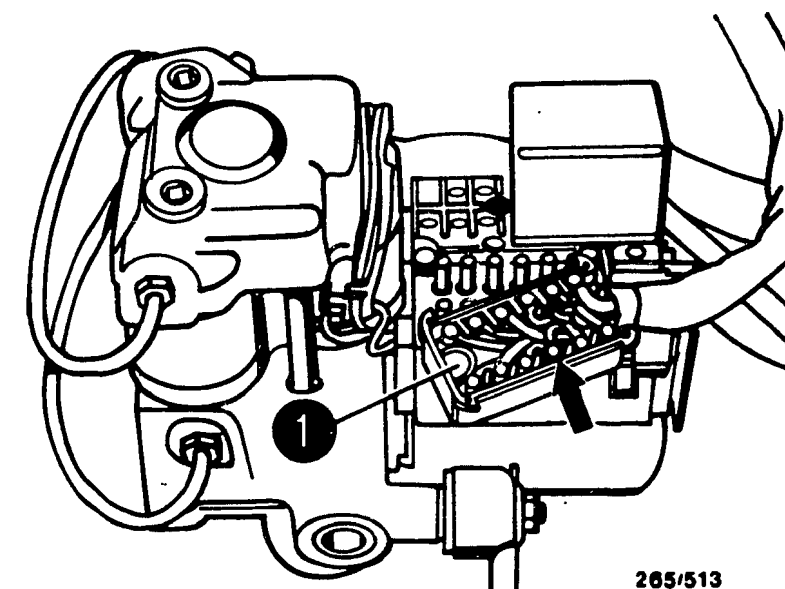
Fill in test report for recording complaints linked to Bosch passenger-vehicle ABS systems and send it to Robert Bosch GmbH, K1/VAK, Robert-Bosch-Str.2 in 7141 Schwieberdingen, West Germany.



285/512

Arrow = Anode end (term. 29)  
1 = Diode

Arrow = Disconnection point for lead (example only!)  
1 = Opened plug of 3-channel hydraulic modulator



285/513

### REPAIR SOLUTION 3:

For 3-channel hydraulic modulators installed in Citroen and Rolls Royce vehicles.

Ignition off.

Detach plug connection of hydraulic modulator with Torx socket wrench TX 15.

Pull out and detach plug connection.

Push wire (e.g. paper clip) through blade contacts and bend over at ends to prevent contacts falling out on opening (see top picture).

Mixing up leads can have catastrophic consequences for ABS control !

Open base of plug. To do so, raise catches somewhat with screwdriver.

Pinch off defective diode. Leave approx. 5 mm of wire.

Solder new diode (BYW 54) with correct polarity to ends of wires.

Solder anode of diode to plug term. 1.

Note: The cathode of the diode is marked, e.g. with a ring.

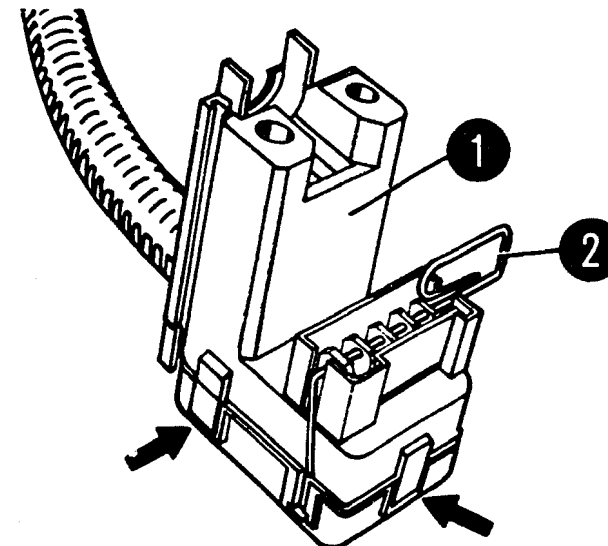
Assemble plug, re-attach it and install.

Check whether warning lamp lights up with controller detached and ignition switched on.

Additionally connect ABS2 LED tester and perform complete test with ABS2 LED tester for safety reasons.

Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

Fill in test report for recording complaints linked to Bosch passenger-vehicle ABS systems and send it to Robert Bosch GmbH, K1/VAK, Robert-Bosch-Str.2 in 7141 Schwieberdingen, West Germany.



285/514

Arrows = Latches

1 = Plug housing

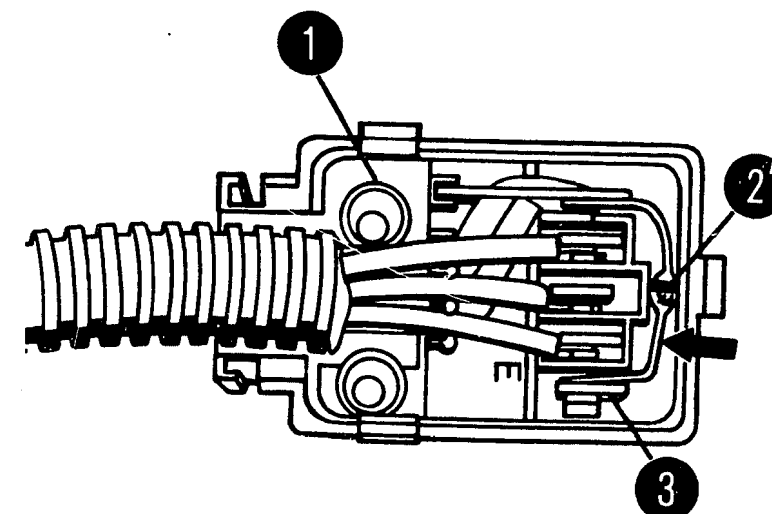
2 = Wire (paper clip)

Arrow = Anode end

1 = Opened plug housing

2 = Diode

3 = Terminal 1



285/515

Trouble-shooting instructions : AUD-5013

BOSCH system : ABS

Make of vehicle : AUDI

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

AUDI 80, 90, (in USA AUDI 4000)  
AUDI 100, 200 (in USA AUDI 5000)  
AUDI Coupe  
as of approx. 8.86

\* ABS with 4 wheel-speed sensors and 4 hydraulic channels.

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

Please refer to basic instructions for a detailed description of trouble-shooting.

NOTE :  
The set values, terminal assignments and special features in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must never be repaired, but rather only replaced as a complete unit.  
Exception: Relay.
- \* Never loosen any screws on hydraulic modulator!  
Such a course of action could lead to fatal brake failure.
- \* Take care when handling brake fluid.  
Toxic!
- \* A limited brake test is permitted, but no performance test.

Refer to basic instructions for further information.

## PREREQUISITES FOR TESTING WITH ABS 2-TESTER

- \* Specified tire size fitted?
- \* Test tightness of ground connection of return pump.
- \* Test tightness of ground connection of Combi relay term. 31 and watch out for corrosion.
- \* Test tightness of ground strap between engine block and vehicle frame.
- \* Test hydraulic connections at hydraulic modulator and sealing points for leakage (visual inspection).
- \* If the ABS warning lamp lights up sporadically when driving (e.g. after switching on loads) and goes out again of its own accord, test battery and voltage supply (alternator, regulator and voltage dips).
- \* If ABS warning lamp is constantly lit and does not go out, check following items:
  - Is controller plug properly attached to controller and engaged ?
  - All plug contacts O.K.?
  - Spring contacts engaged?
  - Check for proper seating of sealing ring in controller plug:  
Curvature downwards.
  - Test wheel-speed-sensor leads at controller plug for correct assignment:

### Wheel-speed sensors:

Front left to term. 5 and term. 4.  
Front right to term. 23 and term. 11.  
Rear left to term. 7 and term. 9.  
Rear right to term. 24 and term. 26.  
Rear axle to term. - and term. -.

### Wheel-speed sensor:

in Audi 80, 90, 100, 200 as of approx. 1.88 front right at term.11 and term.21.

- V-belt snapped?  
(No voltage supply from alternator, charge and ABS warning lamp light up).
- \* Connect ABS2-LED tester to ABS wiring harness.
- Only detach and connect controller with ignition off.
- For test purposes, switch on ignition in all program-selector-switch settings (tester uses power supply from vehicle battery).
- Observe LED (green) for power supply in all program-selector-switch settings.

## C A U T I O N !

Never drive with tester connected!

Brake system must be bled before performing ABS test. Do not actuate ABS tester during bleeding process.

The entire test program is to be repeated whenever repairs have been performed.

The ABS system is a vehicle safety system.

Work on this system presupposes detailed system knowledge.

The conventional brake system must be in proper working order.

### General information on trouble-shooting:

Test all leads for short-circuit to ground and contact with positive leads as well as being on the lookout for worn insulation and squashed leads.

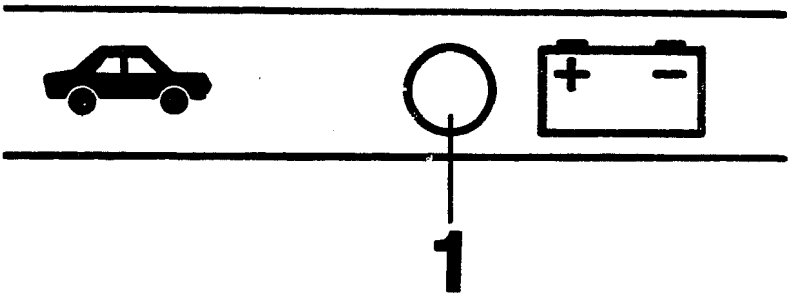
RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch settings 1 to 6

ABS button switched on, lock button switched off

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up all the time	<ul style="list-style-type: none"><li>* Inadequate battery charge</li><li>* Excessive voltage drops</li><li>* Combi relay defective</li><li>* Test lead to driving switch term. 15.</li></ul>

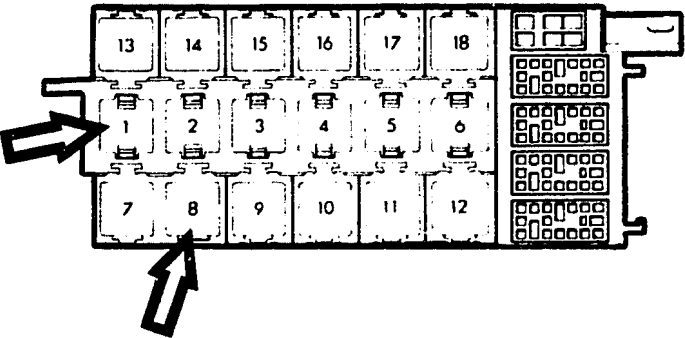


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Arrows = Combi relay in  
auxiliary relay holder

Relay position 1 in  
80/90 quattro

Relay position 8 in 100/200  
quattro

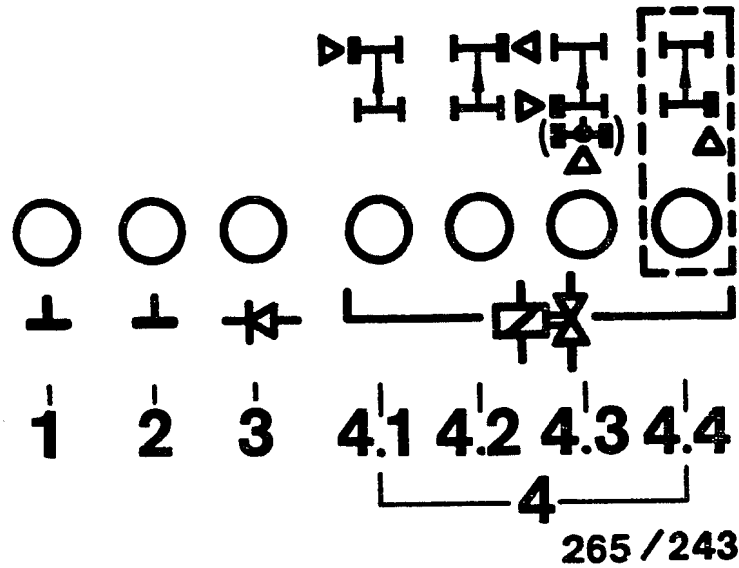


265/478

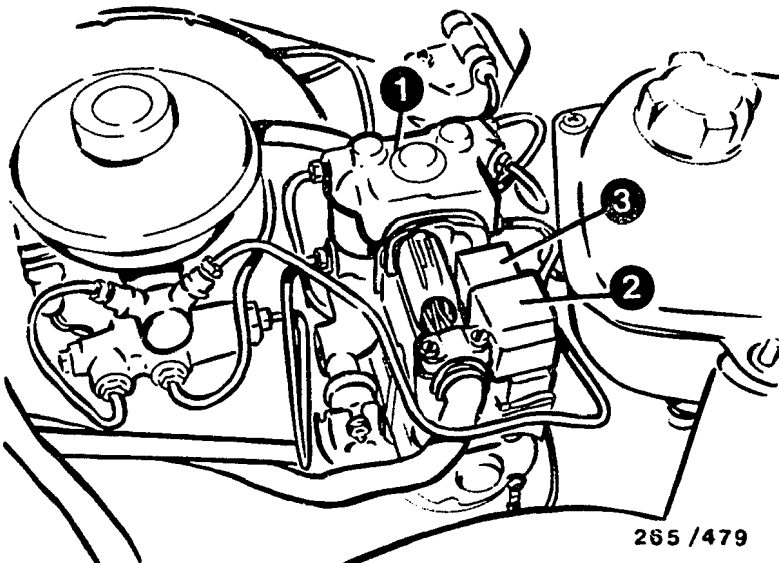
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.35, term.18, term.19)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.  * LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.  * One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.  Solenoid-operated valve internal resistance 0,7...1,7 $\Omega$  * All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.  * Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.  * ABS warning lamp not lit: Warning lamp defective. Note: all other 7 LEDs lit.



1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay

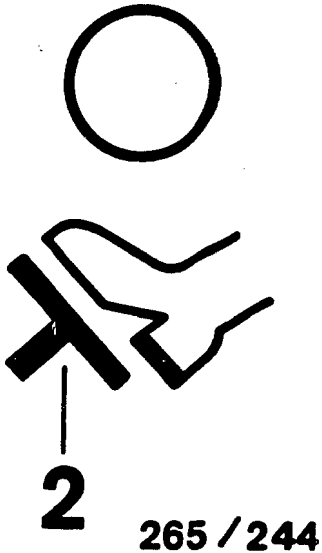




RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

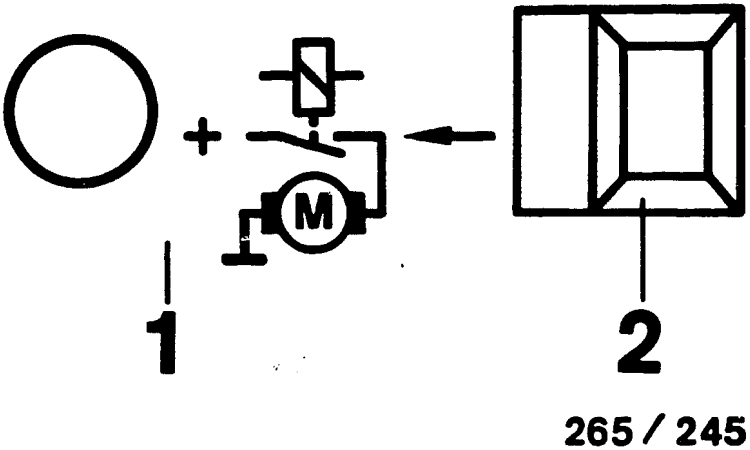


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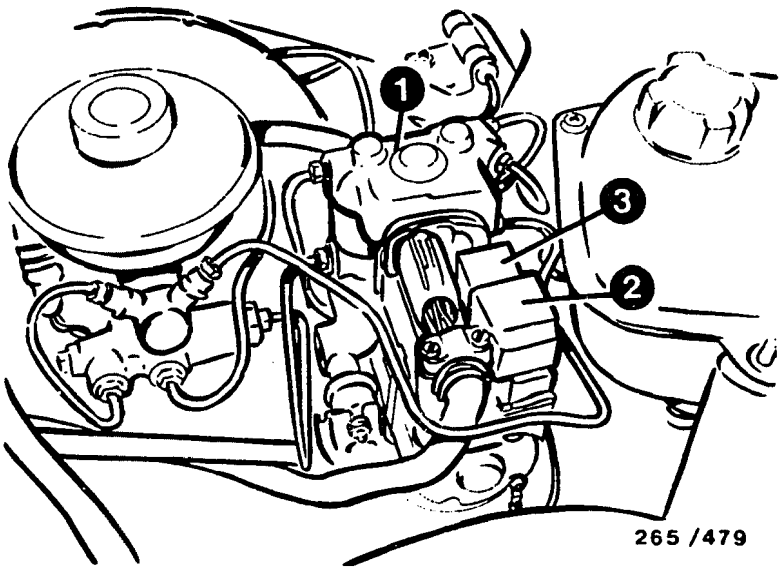
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running.  After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check ground connection and positive terminal of hydraulic modulator</li><li>* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.</li><li>* Pump motor defective</li></ul>

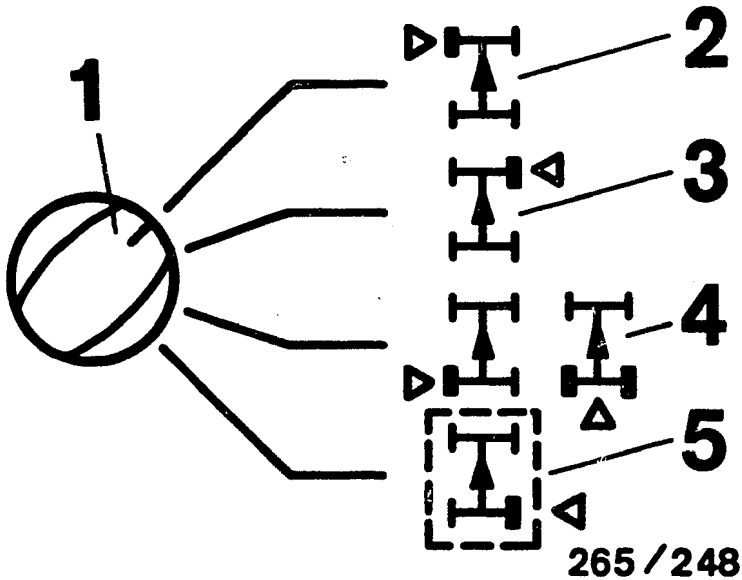
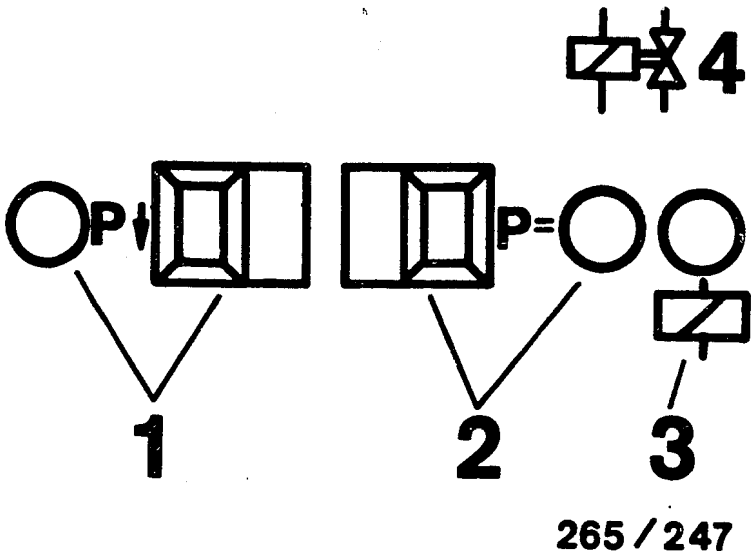


1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (3-channel hydraulic modulator)

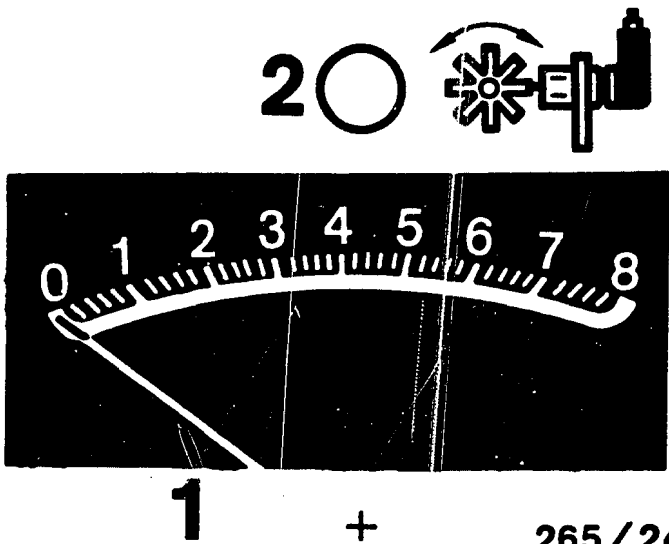
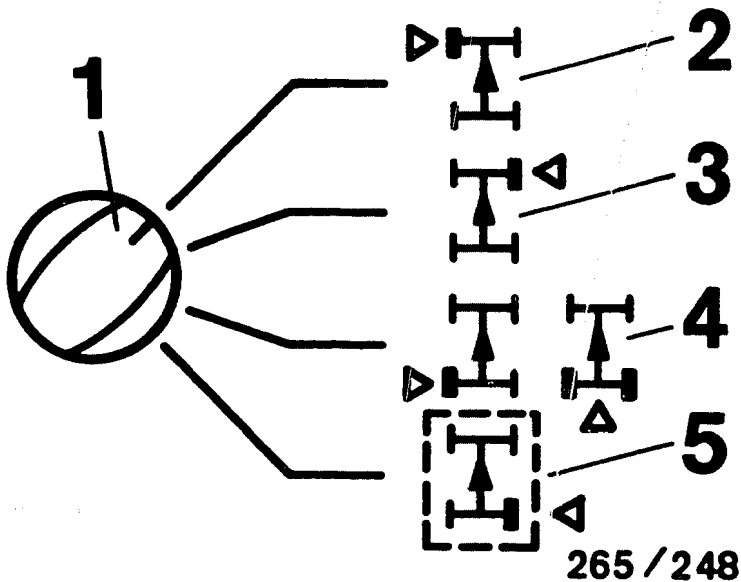
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay opera- tion (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in line from valve relay term. 87 to batt. +ve  * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push- button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push- button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correct- ly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.18 Wheel, rear right: term.19 Rear axle: term.-  * Hydraulic modulator defective
	5.Release push- button P arrow (upper illustration)	LED P arrow (upper illus- tration) goes out, wheel locks	
	6.Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 6 (4 wheel-speed sensor)

Testing of (Measurement at terminals)	Additional operation	Test spec. (Indication)	Possible causes of fault
<p>Wheel-speed sensor for proper func- tioning and mix-up</p> <p>NOTE: Perform test con- secutively for each individual wheel.</p> <p>Front left wheel: Term.5 + term.4</p> <p>Front right wheel: Term.23 + term.21 with 80/90/100/200 as of approx. 1.88 Term.11 + term.21</p> <p>Rear left wheel: Term.7 + term.9</p> <p>Rear left wheel: Term.24 + term.26</p>	<p>Jack up vehicle. Ignition on.</p> <p>It must be possible to turn the wheel to be tested freely by hand.</p> <p>The wheel not being tested must be held when testing the driven axis.</p> <p>Set switch for wheel selection to wheel to be tested (bottom picture)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Then take reading from instrument: (Top picture)</p>	<p>1.Smallest reading greater than 1,0 scale divisions</p> <p>2.Smallest reading greater than 1,6 scale divisions</p> <p>3.Permissible fluctuation span max. 25 % of highest value indicated</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Open-circuit in wheel- speed-sensor lead</p> <p>*Wheel-speed sens.defect.</p> <p>Winding resistance Front and rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Excessive air gap between wheel-speed sensor and ring gear</p> <p>*Ring gear defective or loose</p> <p>*Ring gear fitted has in- correct number of teeth Front axle: 96 teeth Rear axle: 96 teeth For Audi 80/90/100/200 as of approx. 1.88 Front axle: 45 teeth Rear axle: 45 teeth</p> <p>*Exc.wheel-bearing play</p> <p>*Reading provided, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.</p>

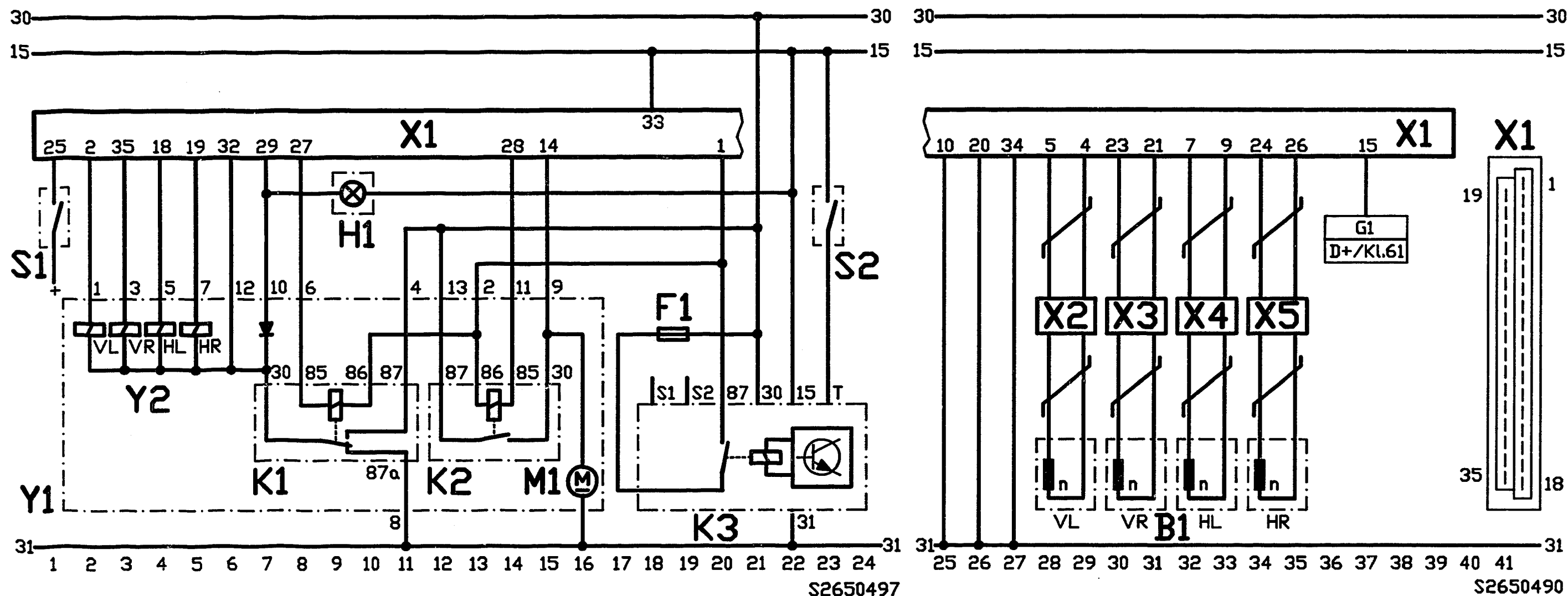


Continue testing on next coordinate.

TEST SPECIFICATIONS

Wheel-speed sensor	
* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:	600...1600 Ω
rear axle:	600...1600 Ω
Hydraulic-modulator solenoid valves	
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7 Ω
Air gap	
	0,8 ±0,5 mm
* Automatically adjusted if use is made of a new cap (part no. 3 330 508 012).	
Tightening torque for	
* fastening screws of wheel-speed sensors:	> 8 Nm
* brake-line connections at hydraulic modulator:	12...16 Nm
Number of teeth	
* Front axle:	96 teeth
* Rear axle:	96 teeth
For AUDI 80, 90, 100, 200 as of approx. 01.88	
* Front axle:	45 teeth
* Rear axle:	45 teeth

For production reasons:  
continued on the following  
coordinate.

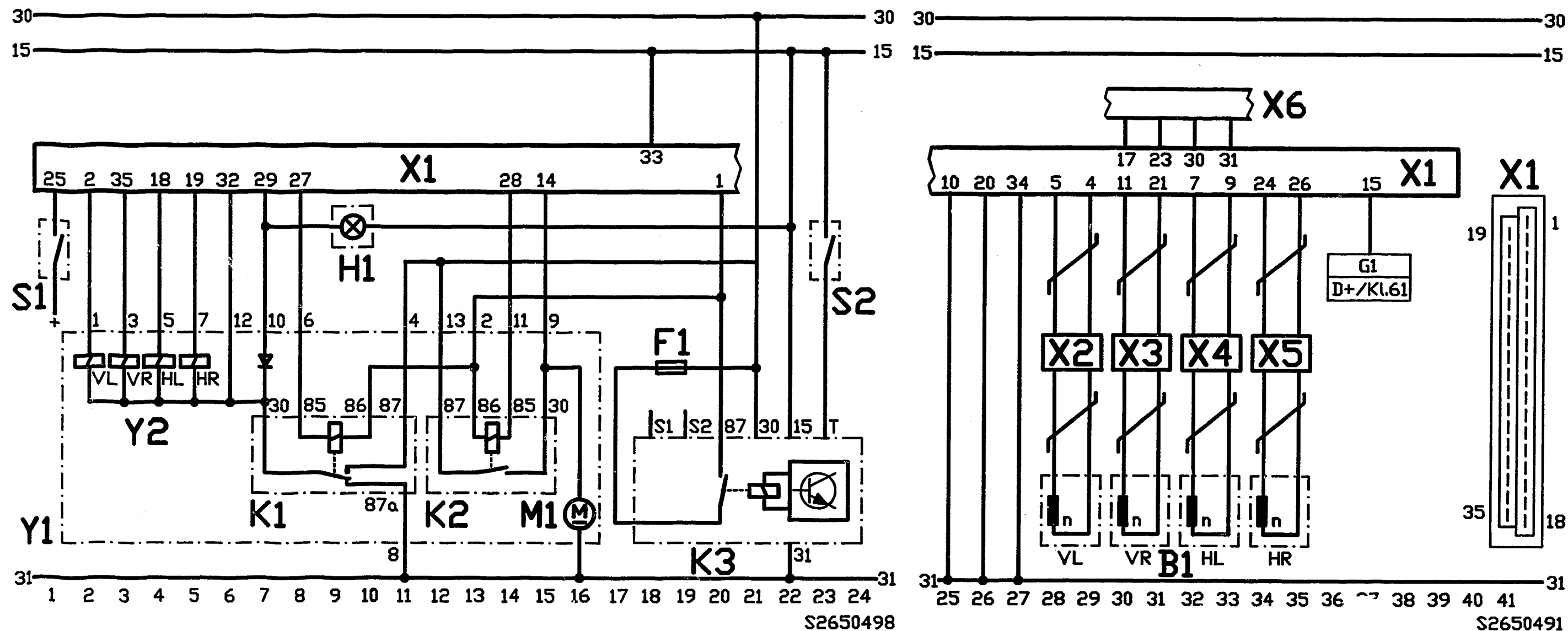


B1 = Wheel-speed sensor  
 G1 = to alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Combi relay  
 M1 = Return pump motor

S1 = Stop-lamp switch  
 S2 = ABS switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valve

VL = Front left  
 VR = Front right  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM → 1.88



B1 = Wheel-speed sensor  
 G1 = to alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Combi relay  
 M1 = Return pump motor

S1 = Stop-lamp switch  
 S2 = ABS switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Multiple butt connector  
 X6 = Plug, wheel-speed-sensor outputs  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM (with additional wheel-speed-sensor outputs) 1.88 ->

## INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel

### \* Controller (top picture):

AUDI 100/200 beneath rear seat bench on left at heel board  
 AUDI 80/90 as of 1987 beneath rear seat bench on left  
 AUDI 80/90 up to 1987 in trunk on right next to fuel tank  
 AUDI Coupe up to 1988 in trunk on right next to fuel tank

### \* Stop-lamp switch

At brake pedal.

### \* ABS warning lamp

In instrument panel.

### \* ABS switch

In instrument panel.

### \* Combi relay (centre picture):

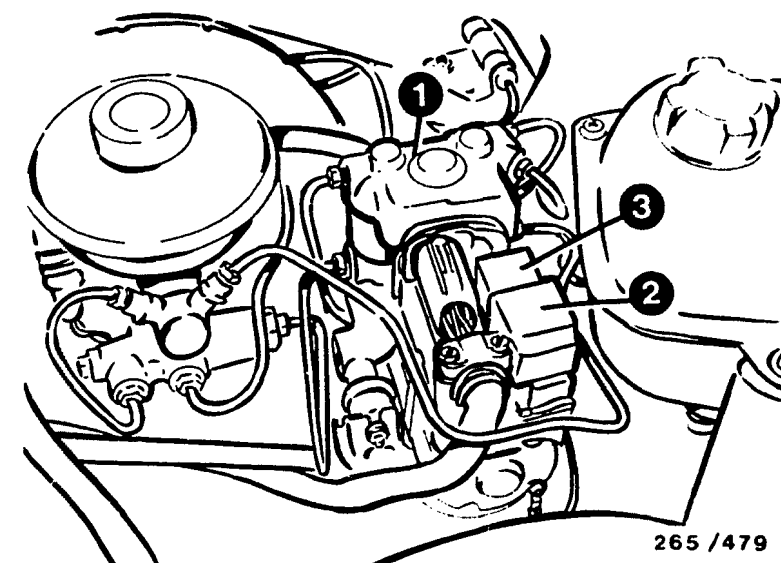
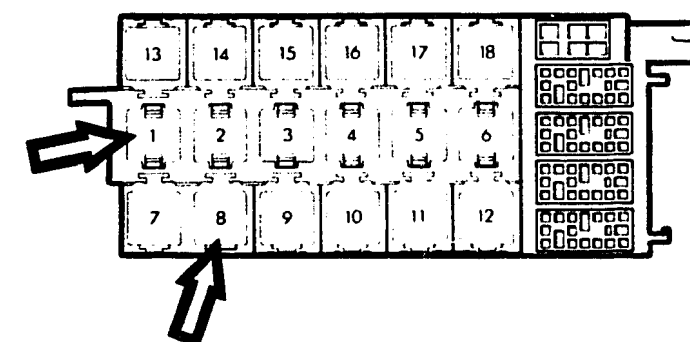
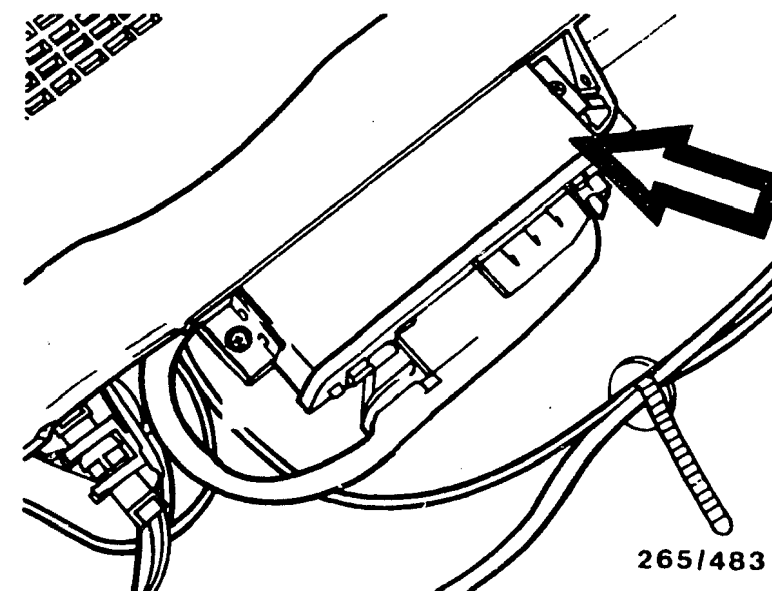
Front left beneath instrument panel, in aux. relay holder  
 Relay position 1 in AUDI 80/90 or relay position 8  
 in AUDI 100/200

### \* Ground terminal for ABS

AUDI 80/90 behind instrument panel on left  
 AUDI 100/200 beneath rear seat bench on right.

### \* Hydraulic modulator (bottom picture):

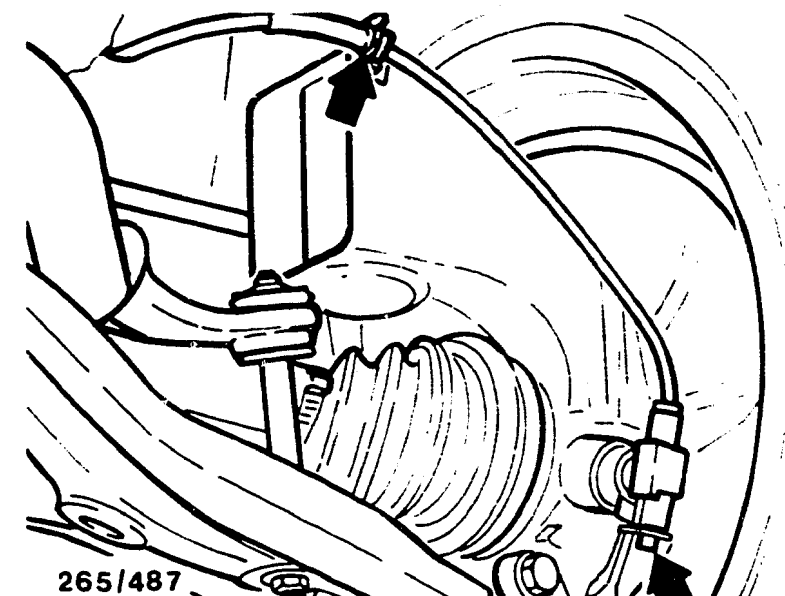
In engine compartment on left in direction of travel.



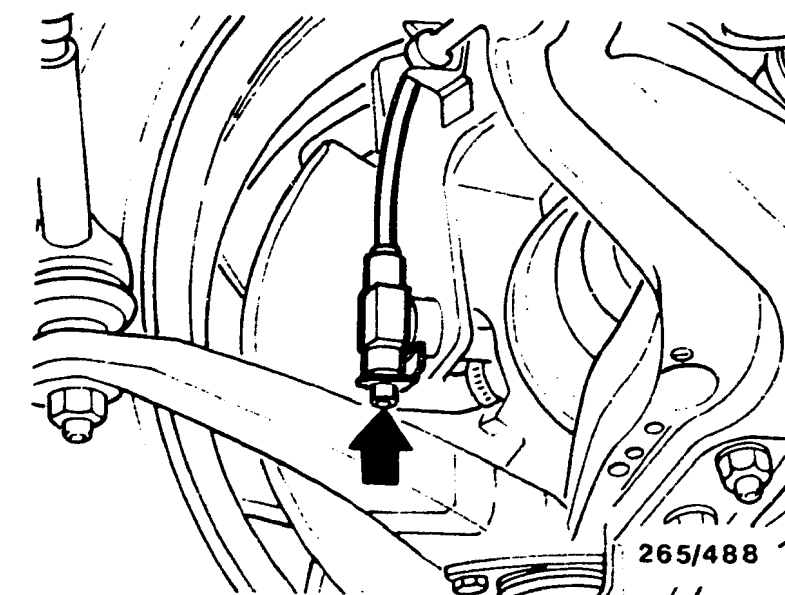


## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Wheel-speed sensor at front axle (top picture):  
Attached on inside on right and left in wheel bearing housing.



- \* Wheel-speed sensor at rear axle (bottom picture):  
One each on left and right at wheel bearing housing.



Trouble-shooting instructions : AUD-5014

BOSCH system : ABS

Make of vehicle : AUDI

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

- AUDI 80, 90 quattro
- AUDI 100, 200 quattro
- AUDI quattro
- AUDI 4000, 5000 quattro
- as of approx. 8.86

- \* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- \* Acceleration sensor (a<sub>L</sub>) as of mid 1987 with the exception of Audi 4000, 5000 quattro

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

A detailed description of trouble-shooting is given in the basic instructions.

NOTE:

The set values, terminal assignments and special features indicated in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator is not to be repaired, but rather only replaced as a complete assembly.  
Exception: relay.
- \* Do not loosen screws on hydraulic modulator! Brake failure may otherwise be fatal.
- \* Take care when handling brake fluid.  
Poisonous!
- \* A limited brake test is permitted, but no performance test.

Refer to basic instructions for further information.

## PREREQUISITES FOR TESTING WITH ABS 2-TESTER

- \* Specified tire size fitted?
- \* Test tightness of ground connection of return pump.
- \* Test tightness of ground connection of Combi relay term. 31 and watch out for corrosion.
- \* Test tightness of ground strap between engine block and vehicle frame.
- \* Test hydraulic connections at hydraulic modulator and sealing points for leakage (visual inspection).
- \* If the ABS warning lamp lights up sporadically when driving (e.g. after switching on loads) and goes out again of its own accord, test battery and voltage supply (alternator, regulator and voltage dips).

\* If ABS warning lamp is constantly lit and does not go out, check following items:

- Is controller plug properly attached to controller and engaged?
- All plug contacts O.K.?
- Spring contacts engaged?
- Check for proper seating of sealing ring in controller plug:  
Curvature downwards.
- Test wheel-speed-sensor leads at controller plug for correct assignment:

### Wheel-speed sensors:

Front left to term. 22 and term. 4.  
Front right to term. 23 and term. 21.  
Rear left to term. 8 and term. 9.  
Rear right to term. 24 and term. 26.  
Rear axle to term. - and term. -.

### Wheel-speed sensor:

on Audi 80, 90, 100, 200 -quattro as of approx.  
1.88 front right to term. 11 and term. 21.

- V-belt snapped?  
(No voltage supply from alternator, charge and ABS warning lamp light up).
- \* Connect ABS2-LED tester to ABS wiring harness.
- Only detach and connect controller with ignition switched off.
- For test purposes, switch on ignition in all program-selector-switch settings (tester uses power supply from vehicle battery).
- Observe LED (green) for power supply in all program-selector-switch settings.

## I M P O R T A N T !

Never drive with tester connected!  
Brake system must be bled before performing ABS test. Do not actuate ABS tester during bleeding process.

The entire test program is to be repeated whenever repairs have been performed.  
The ABS is a vehicle safety system.  
Work on this system requires detailed system knowledge.  
The conventional brake system must be in proper working order.

### General notes on trouble-shooting:

Test all leads for short-circuit to ground and contact with positive leads as well as for worn insulation and crushing.

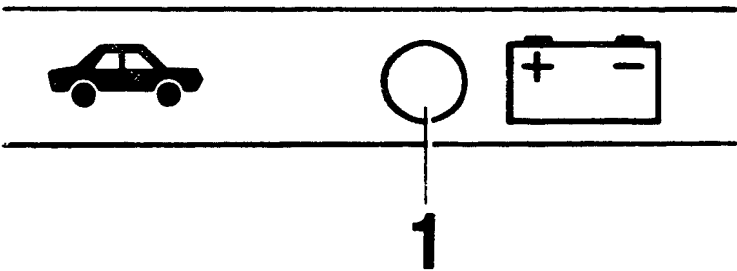
RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch settings 1 to 6

ABS button switched on, lock button switched off

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up all the time	<ul style="list-style-type: none"><li>* Inadequate battery charge</li><li>* Excessive voltage drops</li><li>* Combi relay defective</li><li>* Test lead to driving switch term. 15.</li></ul>

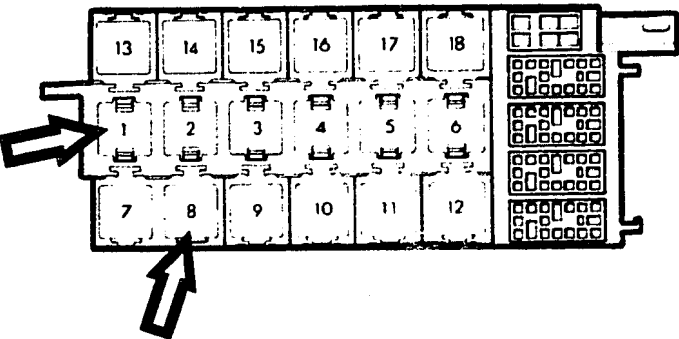


265 / 242

Arrows = Combi relay in  
auxiliary relay holder

Relay position 1 in  
80/90 quattro

Relay position 8 in 100/200  
quattro

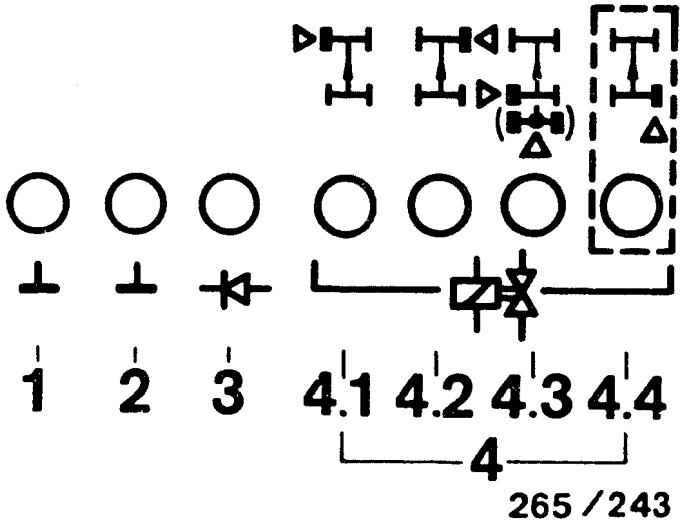


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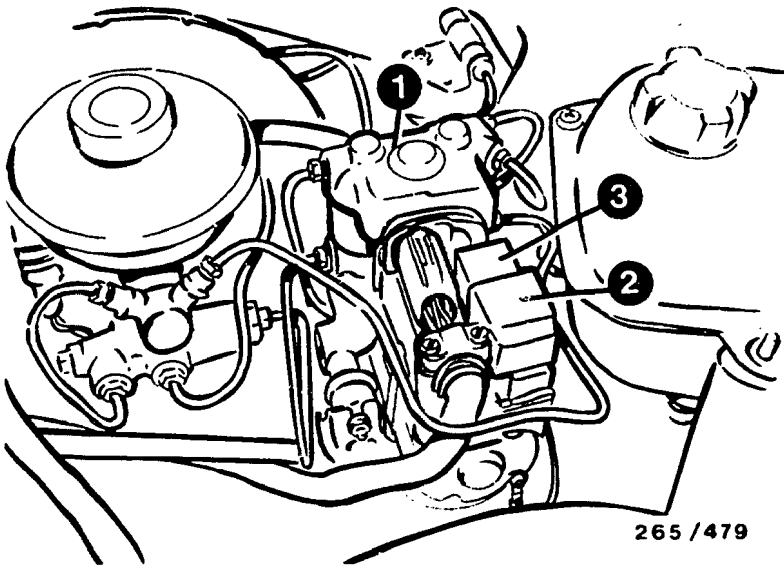
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.  * LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.  * One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.  Solenoid-operated valve internal resistance 0,7...1,7 Ω  * All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.  * Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.  * ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



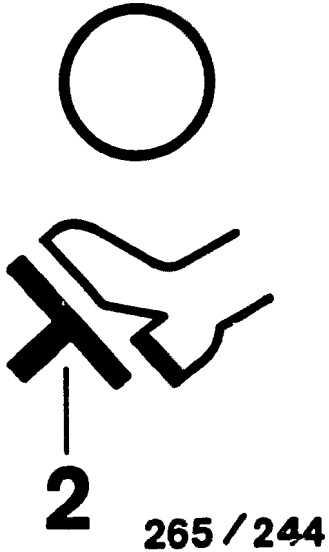
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

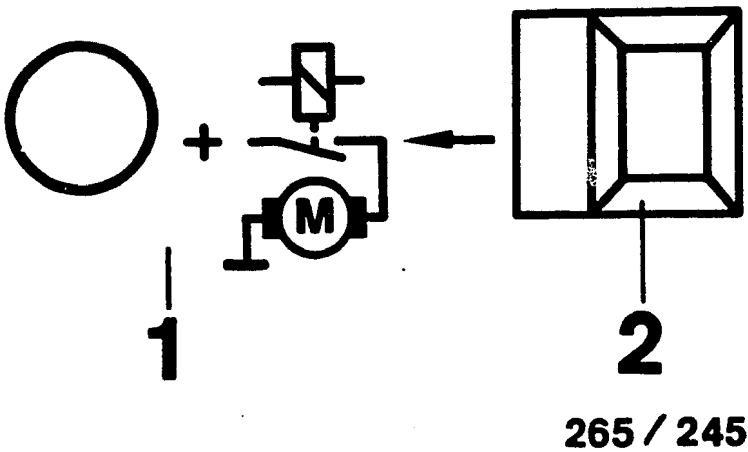


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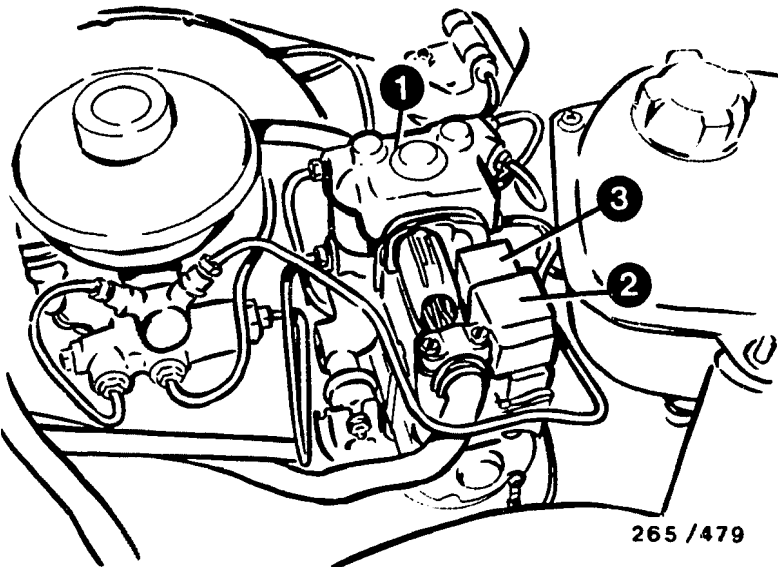
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running.  After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check ground connection and positive terminal of hydraulic modulator</li><li>* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.</li><li>* Pump motor defective</li></ul>



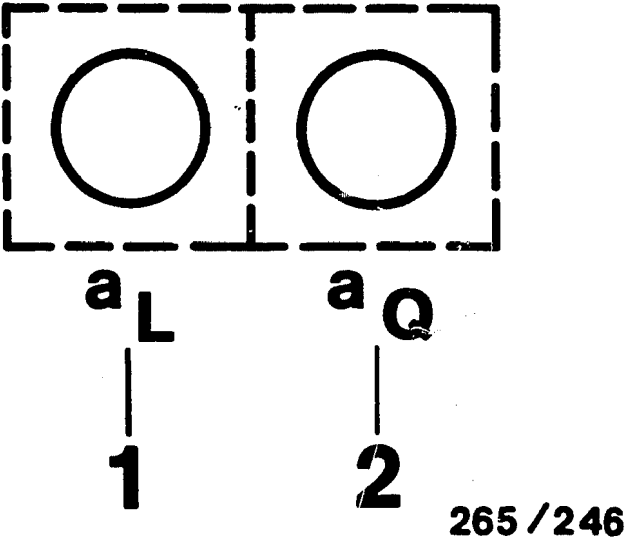
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



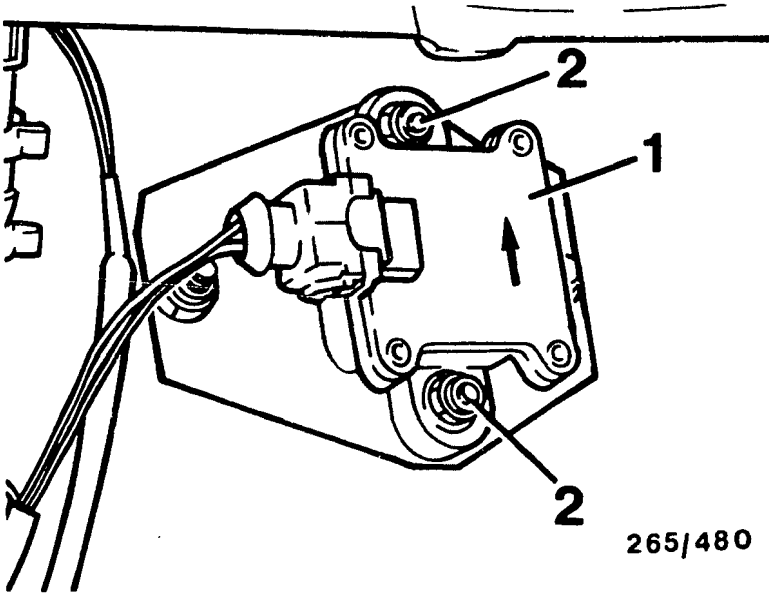
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 4

Testing of (measurement at terminals)	Add- itional operation	Test specification (indication)	Possible causes of fault
Acceleration sensor a L (term. 16)	Ignition on	LED a L lights up	<div>* Test acceleration sensor: Resistance: 500...800 Ω Replace sensor: Use self-locking nuts again to attach sensor. Pay attention to installation position. Arrow on sensor must face in direction of travel.</div> <div>* Test lead from acceleration sensor to ABS controller term. 16.</div> <div>* Test lead from controller term. 1 to acceleration sensor.</div>



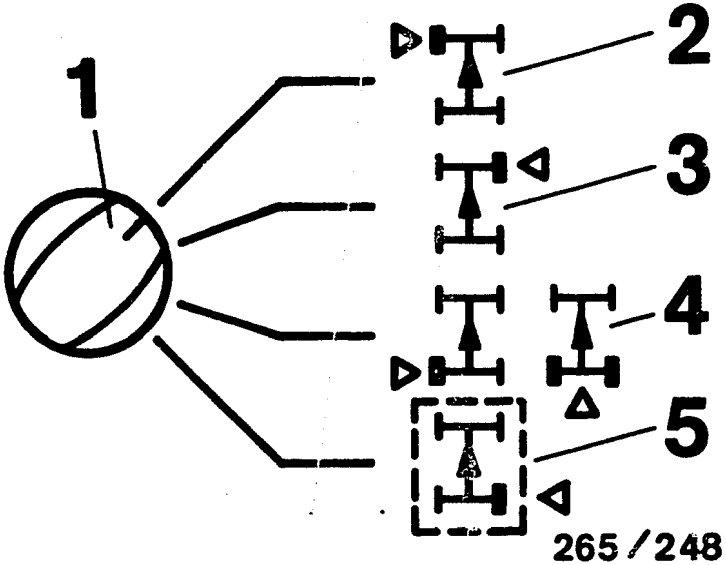
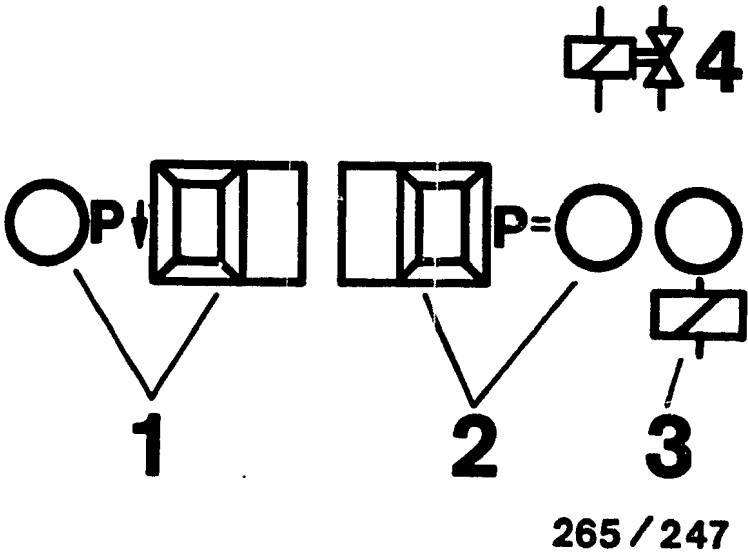
1 = Acceleration sensor  
2 = Self-locking nut  
Arrow = Direction of travel





RAPID DIAGNOSIS CHART (CONTINUED)  
 Program-selector-switch position 5 (3-channel hydraulic modulator)

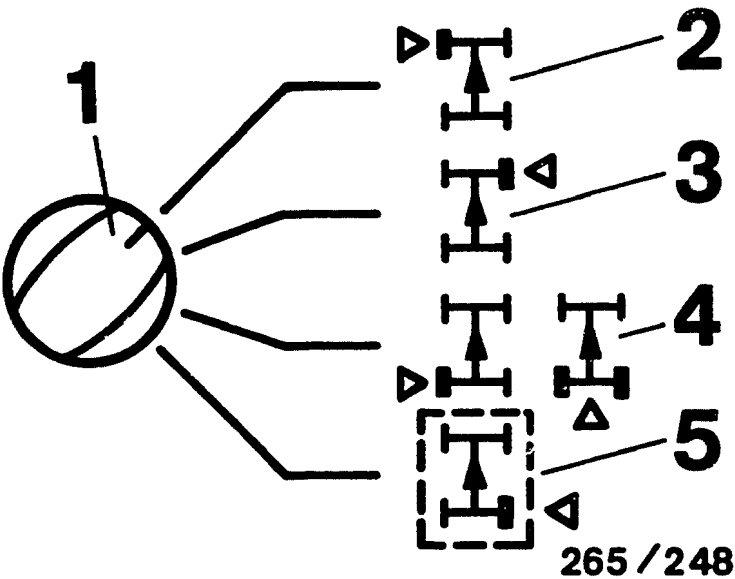
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in line from valve relay term. 87 to batt. +ve  * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18  * Hydraulic modulator defective
	5.Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6.Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

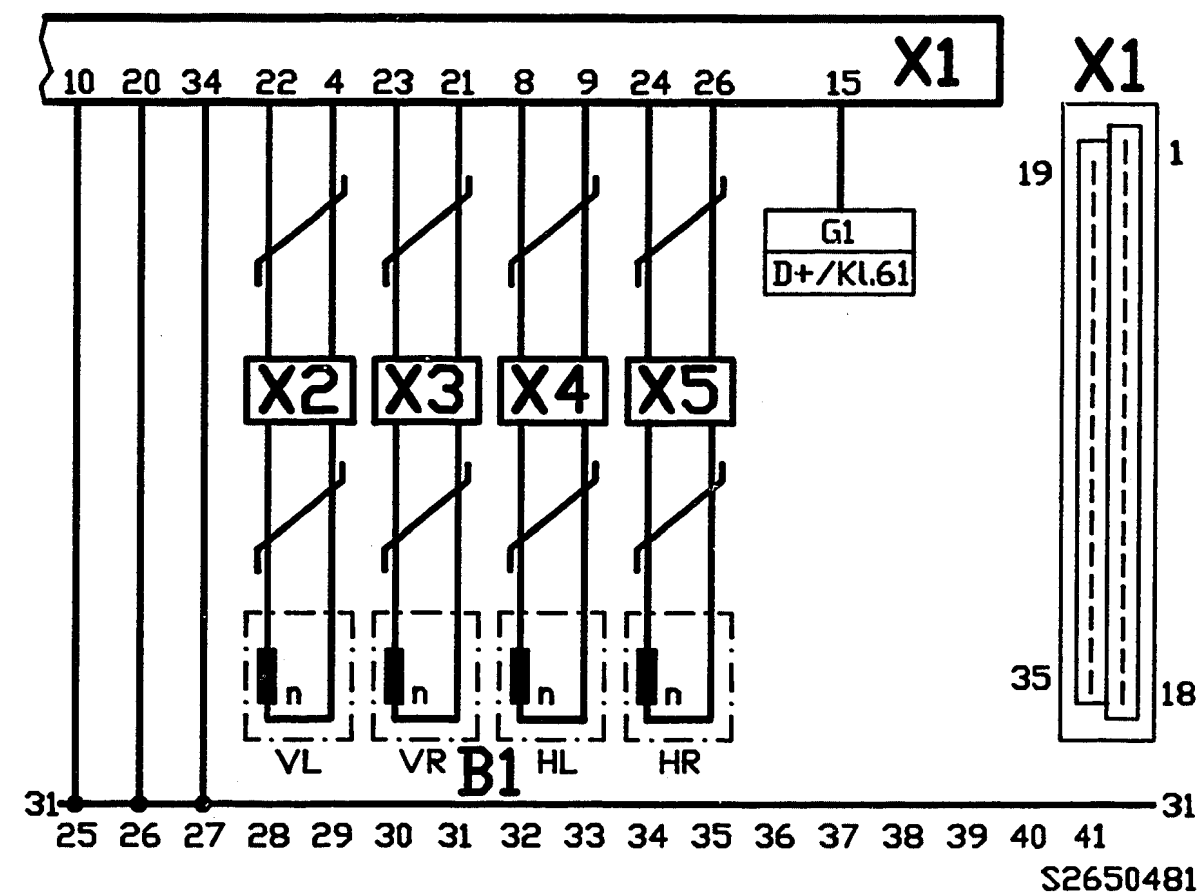
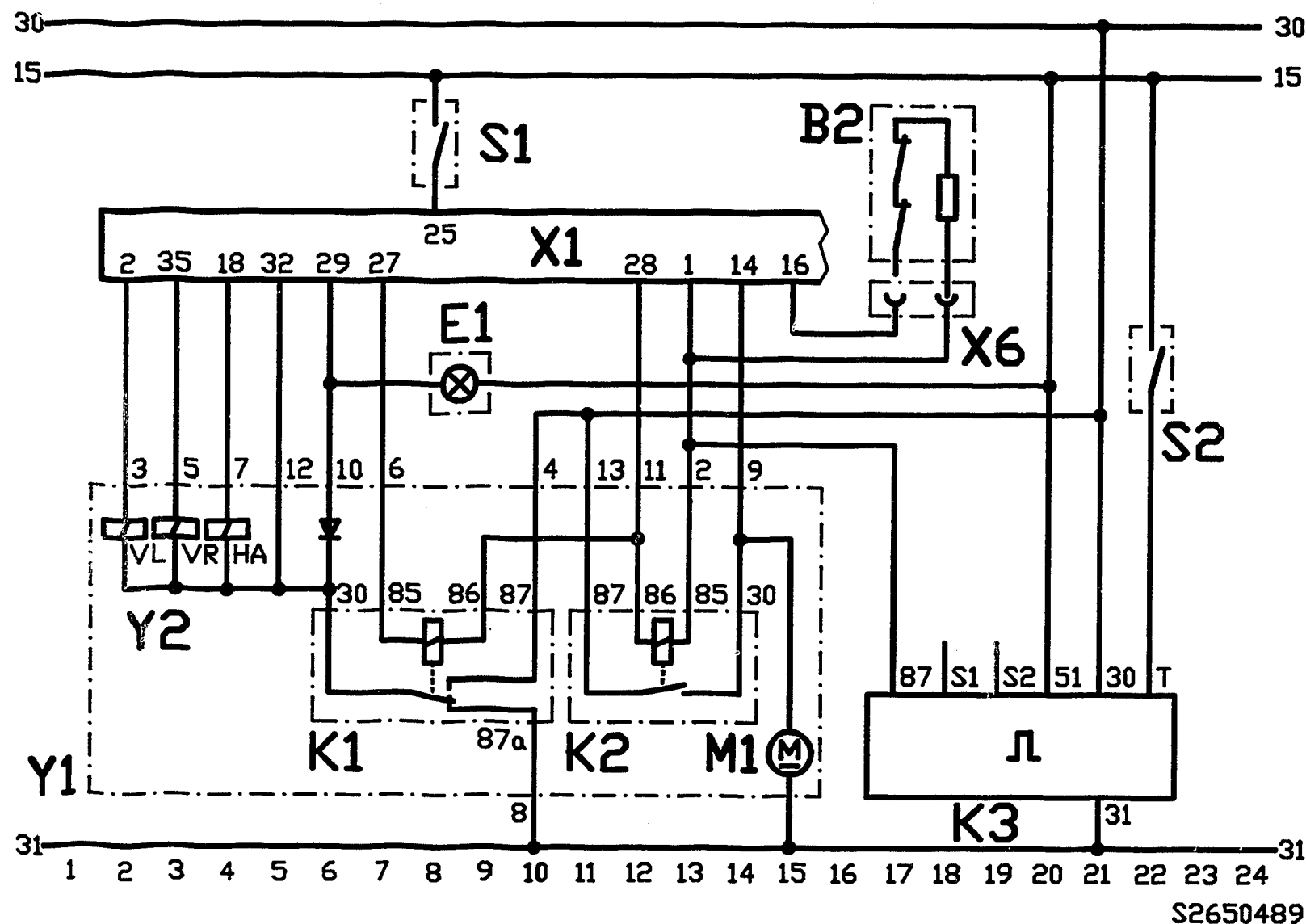
Program-selector-switch setting 6 (4 wheel-speed sensor)

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Wheel-speed sensor for proper func- tioning and mix-up  NOTE: Perform test consecutively for each individual wheel.  Wheel, front left: term.4 + term.22  Wheel, front right: term.23 + term.21 on 80/90/100/200 quattro as of approx. 1.88 term.21 + term.25  Wheel, rear left: term.8 + term.9  Wheel, rear left: term.24 + term.26	Jack up vehicle. Ignition on.  It must be possible to turn the wheel to be tested freely by hand.  The wheel not being tested must be held when testing the driven axle.  Set switch for wheel selection to wheel to be tested (bottom picture)  Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 rev- olution per second). Then read off value indicated on instrument: (top picture)	1. Smallest reading greater than 1,0 scale divisions  2. Smallest reading greater than 1,6 scale divisions  3. Permissible fluctuation band max. 11 % of maximum value displayed.	*Wheel-speed-sensor lead mixed up  *Open-circuit in wheel- speed-sensor lead  *Wheel-spd.-sens. defect.  Winding resistance front and rear axle: 0,6...1,6 k $\Omega$  *Excessive air gap between wheel-speed sensor and ring gear  *Ring gear defective or loose  *Ring gear installed has incorrect no. of teeth Front axle: 96 teeth Rear axle: 96 teeth On Audi 80/90/100/200 quattro as of approx. 1. 88 Front axle: 45 teeth Rear axle: 45 teeth *Excessive wheel bearing play *Reading given, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.



Continue testing on next coordinate.



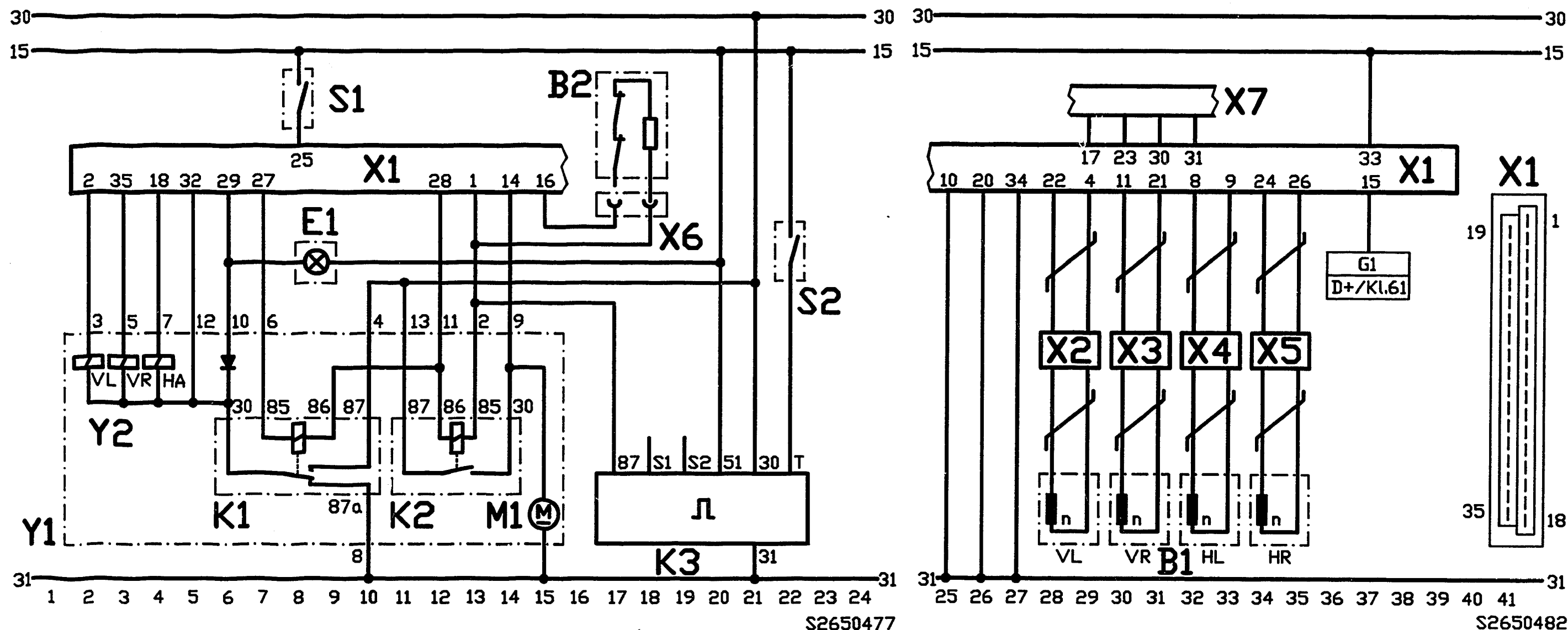


B1 = Wheel-speed sensor  
 B2 = Acceleration sensor (a<sub>L</sub>)  
 H1 = ABS warning lamp  
 G1 = to alternator  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Comb1 relay

M1 = Return-pump motor  
 S1 = ABS button  
 S2 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X6 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 HA = Rear axle  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM →1.88



B1 = Wheel-speed sensor  
 B2 = Acceleration sensor (a<sub>L</sub>)  
 H1 = ABS warning lamp  
 G1 = to alternator  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Combi relay

M1 = Return-pump motor  
 S1 = ABS button  
 S2 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X6 = Multiple butt connector  
 X7 = Plug, wheel-speed-sensor outputs  
 Y1 = Hydraulic modulator

Y2 = Solenoid valves  
 VL = Front left  
 VR = Front right  
 HA = Rear axle  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM (with additional wheel-speed-sensor outputs) 1.88 →

## INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

- \* Controller (top picture):  
Beneath seat bench, rear left.

AUDI 100/200 quattro: Beneath rear seat bench, on left, at heel board.

AUDI 80/90 quattro as of 1987: Beneath rear seat bench, left.

AUDI 80/90 quattro up to 1987: In trunk, right, next to fuel tank.

AUDI Coupe quattro up to 1988: In trunk, right, next to fuel tank.

AUDI quattro: In trunk, right, next to fuel tank

- \* Stop-lamp switch:  
At brake pedal.

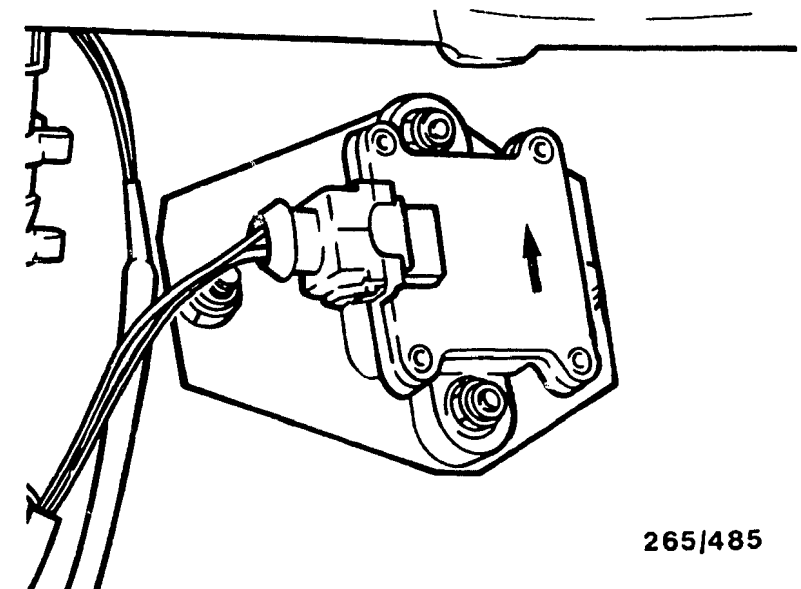
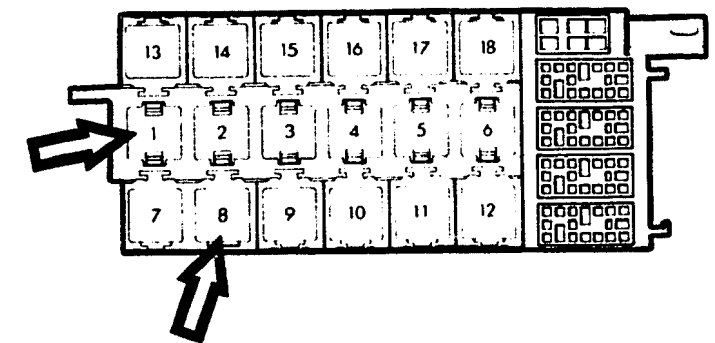
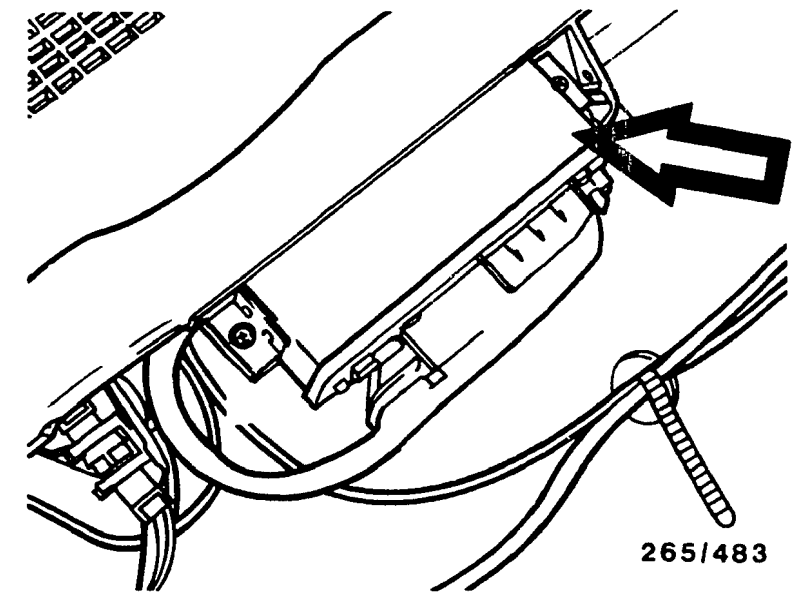
- \* ABS warning lamp:  
In instrument panel.

- \* ABS switch:  
In instrument panel

- \* Combi relay (center picture):  
Front left beneath instrument panel, relay position 1  
in auxiliary relay holder on Audi 80/90 quattro or relay  
position 8 on Audi 100/200 quattro, 5000 quattro.

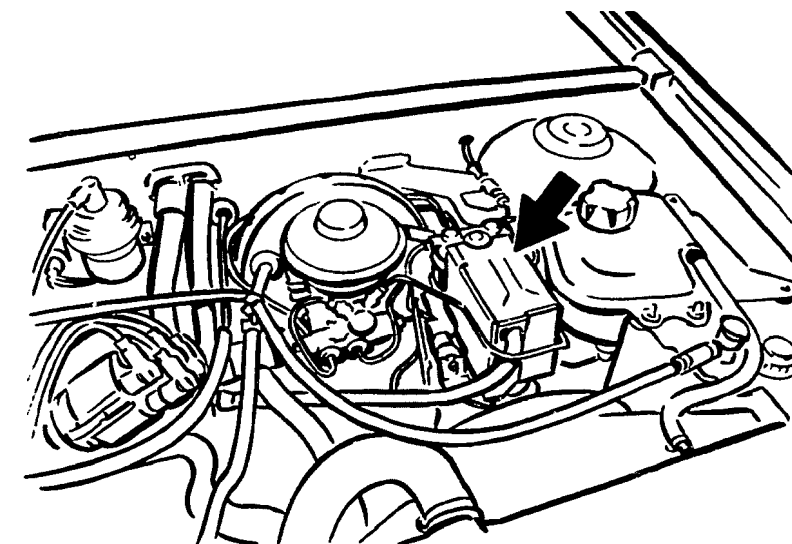
- \* Ground terminal for ABS:  
AUDI 80/90 quattro: Behind instrument panel, left  
AUDI 100/200 quattro, 5000 quattro: Beneath rear seat bench, right.

- \* Acceleration sensor (a<sub>L</sub>) (bottom picture):  
Beneath seat bench, rear left.  
Arrow a on sensor faces in direction of travel.



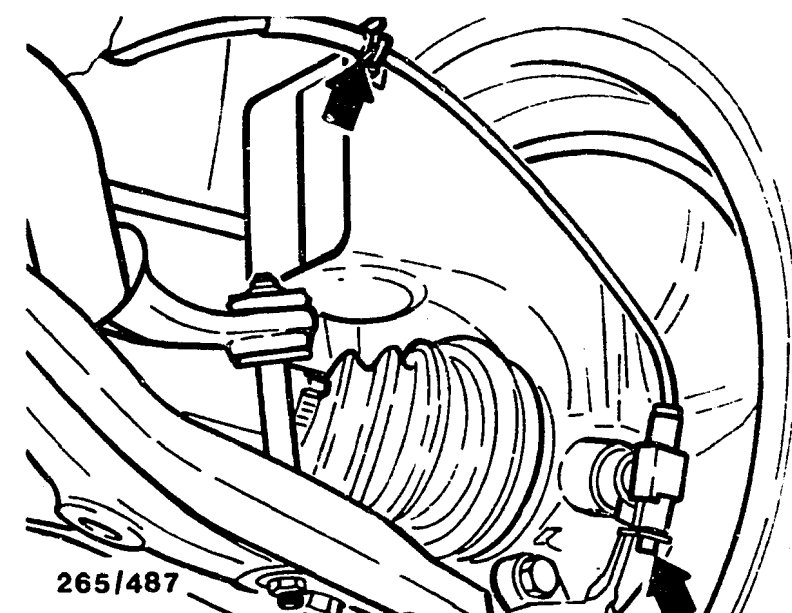
## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Hydraulic modulator (top picture):  
In engine compartment on left in direction of travel.



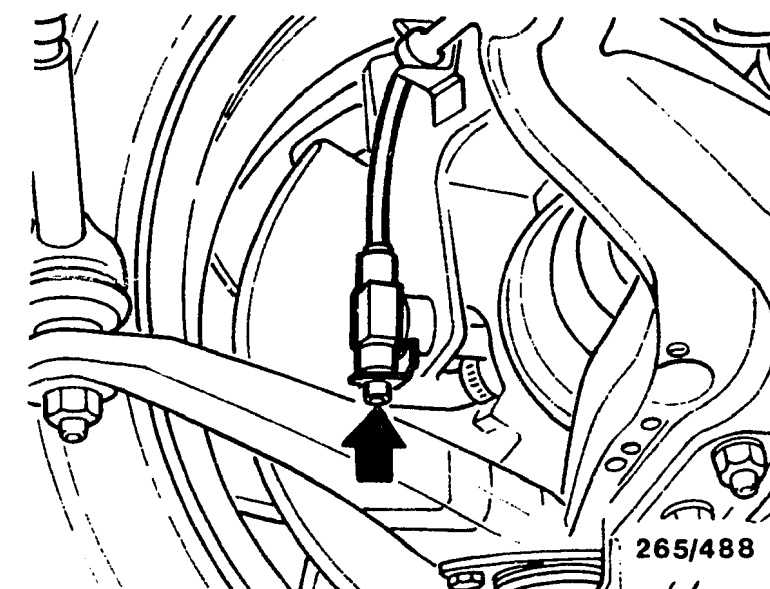
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- \* Front-axle wheel-speed sensor (center picture):  
Attached on inside on right and left in wheel bearing housing.



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- \* Rear-axle wheel-speed sensor (bottom picture):  
One each on left and right at wheel bearing housing.



265/488

Trouble-shooting instructions : BMW-5014

BOSCH system : ABS

Make of vehicle : BMW

Basic microcard : PKW-040

TABLE OF CONTENTS

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Structure, usage .....	02
Safety and precautionary measures .....	02
Test requirements .....	03
Rapid diagnosis chart .....	05
Test specifications .....	20
Electrical terminal diagram .....	21
Installation position of components, notes on removal and installation .....	23

SPECIAL FEATURES

This microcard, valid at the time of publication, applies to the following vehicle models:

BMW 730 i (E 32), 9.86 ->  
BMW 735 i (E 32), 9.86 ->  
BMW 750 i (E 32), 9.87 ->  
BMW 750 iL (E 32), 9.87 ->

- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gear with 48 teeth.
- \* Note:  
Vehicles with ABS/ETC have their own instructions.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.



## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 7 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

## General information for trouble-shooting:

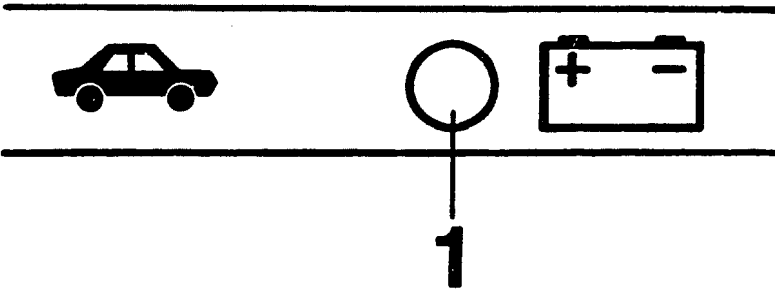
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

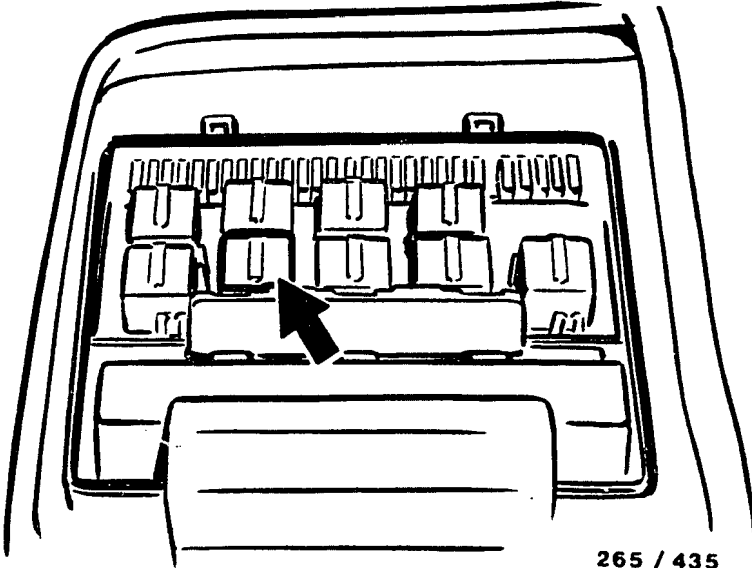
Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply  (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none"><li>*Battery insufficiently charged</li><li>*High voltage drops</li><li>*Overvoltage-protection relay defective</li><li>*Check lead to ignition and starting switch, term. 15</li></ul>



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Arrow = Overvoltage-protection relay

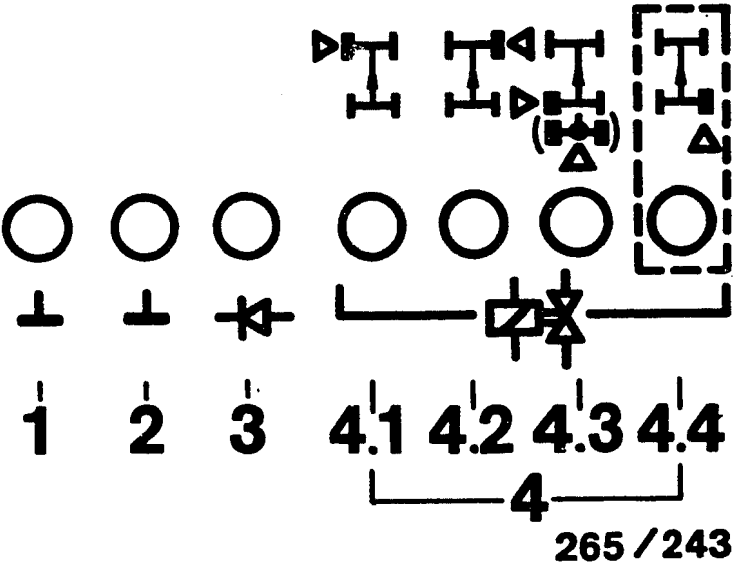


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RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

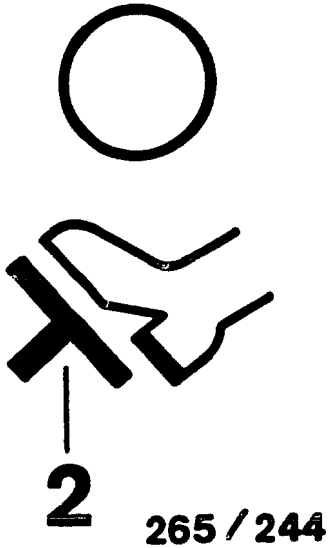
Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



RAPID DIAGNOSIS CHART (CONTINUED)

Program switch setting 2

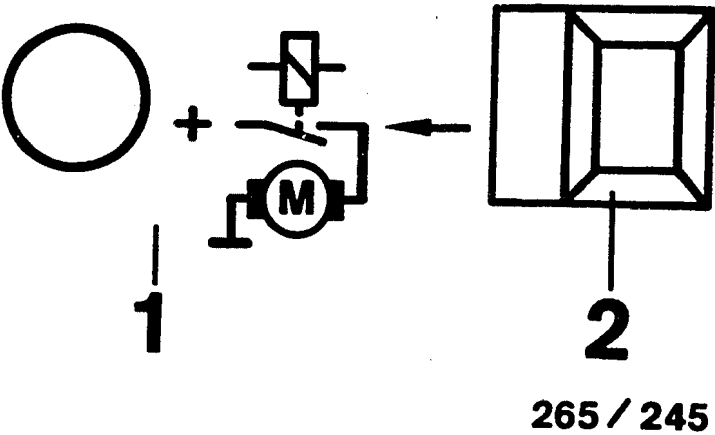
Testing of (measurement at terminals)	Addition- al operation	Test specifica- tion (indication)	Possible causes of fault
Alternator voltage of term.61 (term.15)	Ignition on	LED 1 (top picture) lights up.	* LED sometimes only goes out after accelerating (test is thus O.K.)
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead to alternator term.61  * Alternator defective.
Brake-light switch (term.25)	Ignition on	LED 2 (top picture) lights up	* Brake-light switch defective.  * Test lead to brake-light switch.
	Depress brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to brake-light switch.



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 3

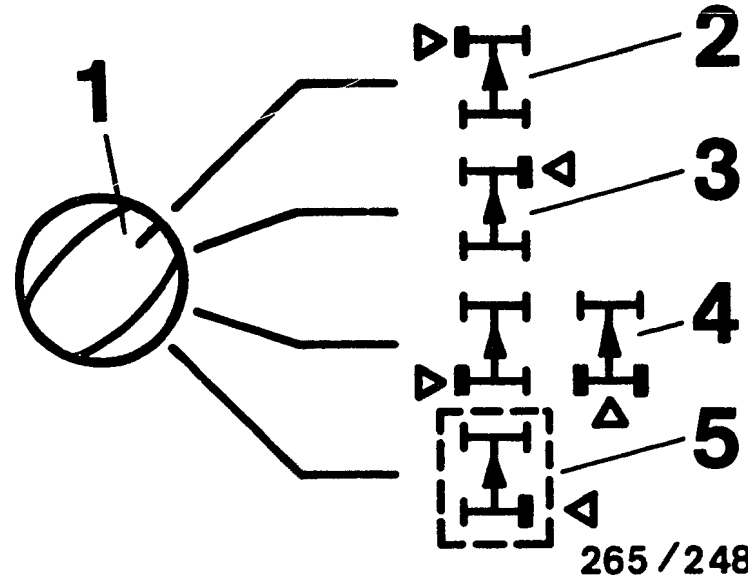
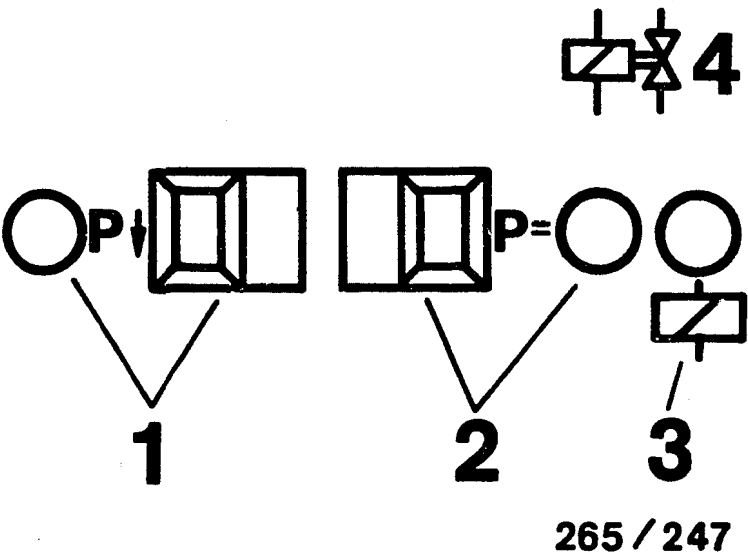
Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 11 (12: 09.87-&gt;) or term. 2 (8: 09.87-&gt;). Positive lead to hydraulic modulator term. 4.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



Program-selector-switch position 4 not applicable.

RAPID DIAGNOSIS CHART (CONTINUED)  
Program switch setting 5 (4-channel hydraulic modulator)

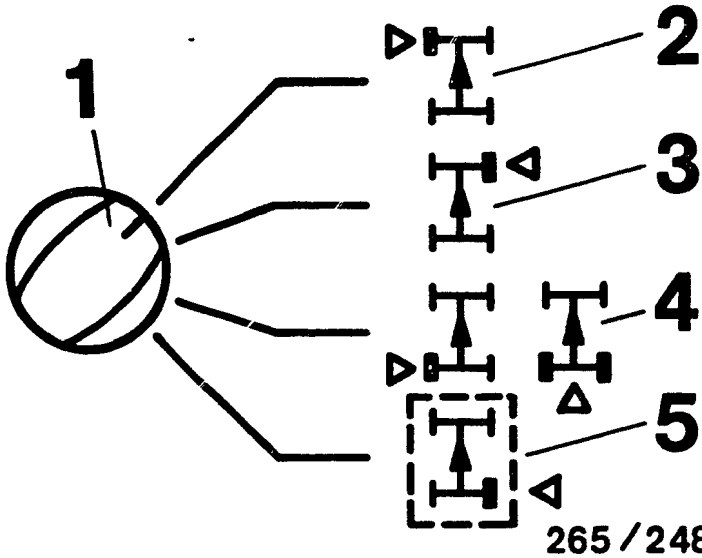
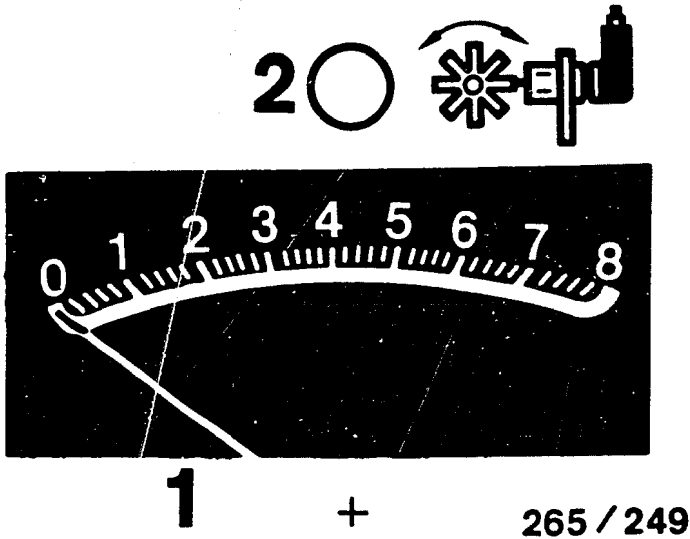
Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Valve relay func- tion (term. 27)	Ignition on	LED 3 (top picture) lights up	* Valve relay (winding) or leads defective
Check solenoid valves in hydraulic modu- lator for proper functioning and mix-up. NOTE: Perform test con- secutively for each individual wheel. Comply with operating sequence!	Check up vehicle. Ignition on. It must be possible to turn the wheel to be tested freely by hand. Set switch 1 for wheel selection to wheel to be tested (bottom picture).		* Repeat test with engine running  * Valve relay (make contact) defective  * Open-circuit in lead from valve relay, term. 87 to B+  * Brake lines mixed up at hydraulic modulator
Function Pressure retention	1. Press button P= (top picture) constantly	LED P= (top picture) lights up	* Current value is not attained (LED P arrow or P= off; top picture): Insufficient battery charge. Repeat test with engine running.
	2. Constantly depress brake pedal	Wheel can be turned by hand	
	3. Release button P= (top picture)	LED P= goes out (top picture) Wheel locks	
Function Pressure reduction	4. Press button P arrow (top picture)	LED P arrow (top picture) lights up, wheel can be turned by hand	* Proper electrical connection of solenoid valves? Front left wheel: term. 2 Front right wheel: term.35 Rear left wheel: term.18 Rear right wheel: term.19 Rear axle: term.—  * Hydraulic modulator defective
	5. Release button P arrow (top picture)	LED P arrow (top picture) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and t.6</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,6 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance</p> <p>Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed</p> <p>Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



## TEST SPECIFICATIONS

## Wheel-speed sensor

- \* Winding resistance at ambient temperature ( $-10^{\circ}\text{C} \dots +120^{\circ}\text{C}$ ) for

**600...1600 Ω**

600...1600 Ω

## Hydraulic-modulator solenoid-operated valves

- \* Winding resistance at ambient temperature ( $-10^{\circ}\text{C} \dots +120^{\circ}\text{C}$ ):

 $0,7 \dots 1,7 \quad \Omega$ 

Air gap:

$0,8 \pm 0,5 \text{ mm}$

### Tightening torque for

- \* Fastening screws of wheel-speed sensors:

**> 8 Nm**

- \* Brake-line connections on hydraulic modulator:

**12...16 Nm**

**Number of teeth**

- \* Front axle:

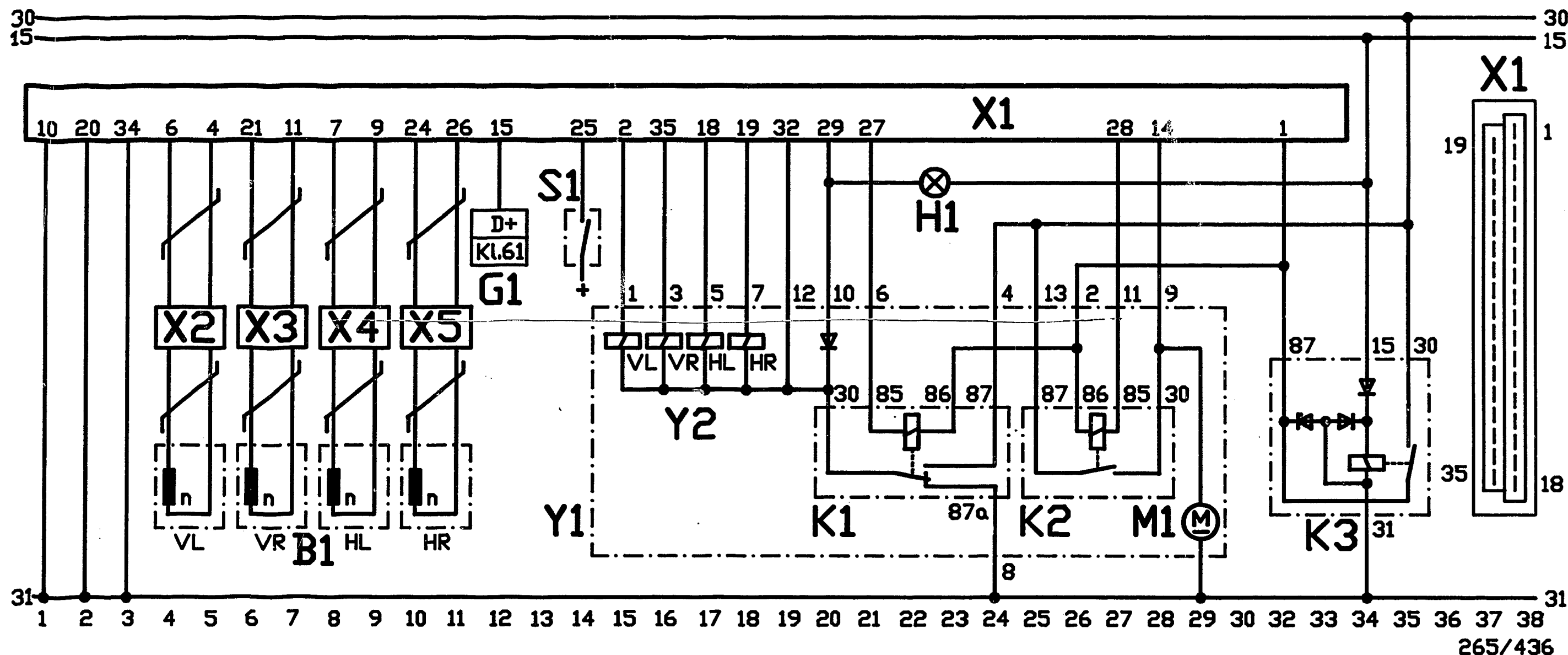
**48 teeth**

- \* Rear axle:

**48 teeth**

For production reasons:  
continued on the following  
coordinate.



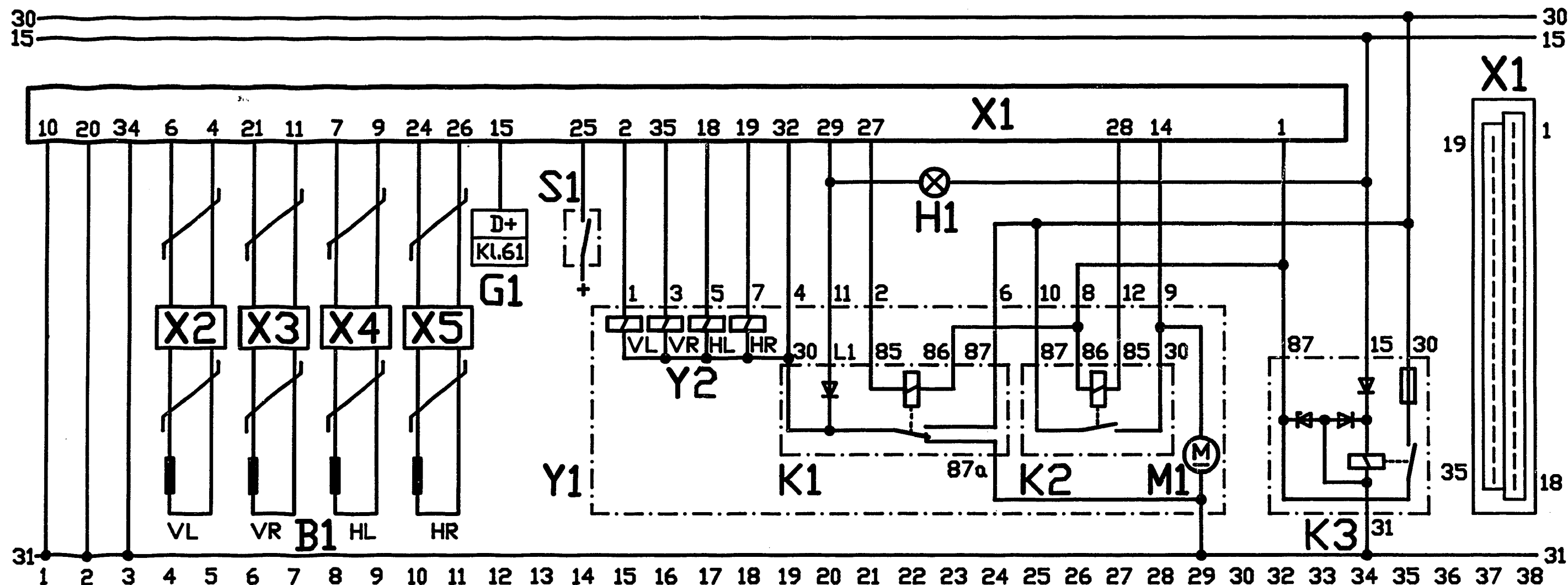


B1 = Engine-speed sensor  
 G1 = To alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay

K3 = Overvoltage-protection relay  
 M1 = Return-supply-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pin)  
 X2...X5 = Engine-speed-sensor plug

Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves  
 HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right

ELECTRICAL TERMINAL DIAGRAM 09.86 -> 08.87



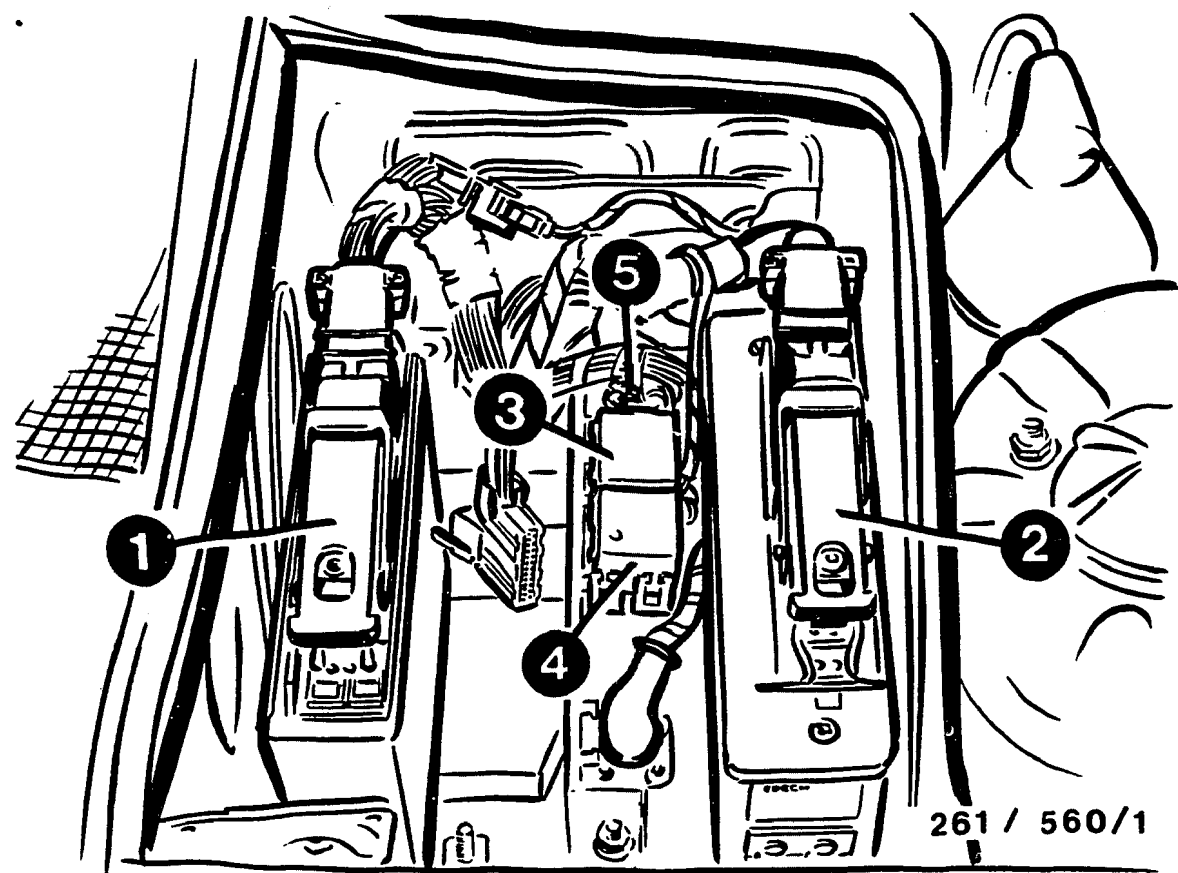
265/437

B1 = Engine-speed sensor  
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 M1 = Return-supply-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pin)  
 X2...X5 = Engine-speed-sensor plug

Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves  
 HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right

ELECTRICAL TERMINAL DIAGRAM 09.87 ->



1 = Motronic control unit in 735i  
2 = ABS controller

#### INSTALLATION POSITION OF COMPONENTS

##### ABS controller:

In the engine compartment beneath the hood on the right-hand side.

Unscrew cover.

Remove plug:

Lift up latching clip or, as the case may be, push back spring and unhook plug from the mechanical encoder at the wiring-harness end.

##### ABS warning lamp:

In the instrument cluster.

Marking: ABS.

##### Ground terminal:

In the engine compartment at the control-unit box on the left beneath a cover.

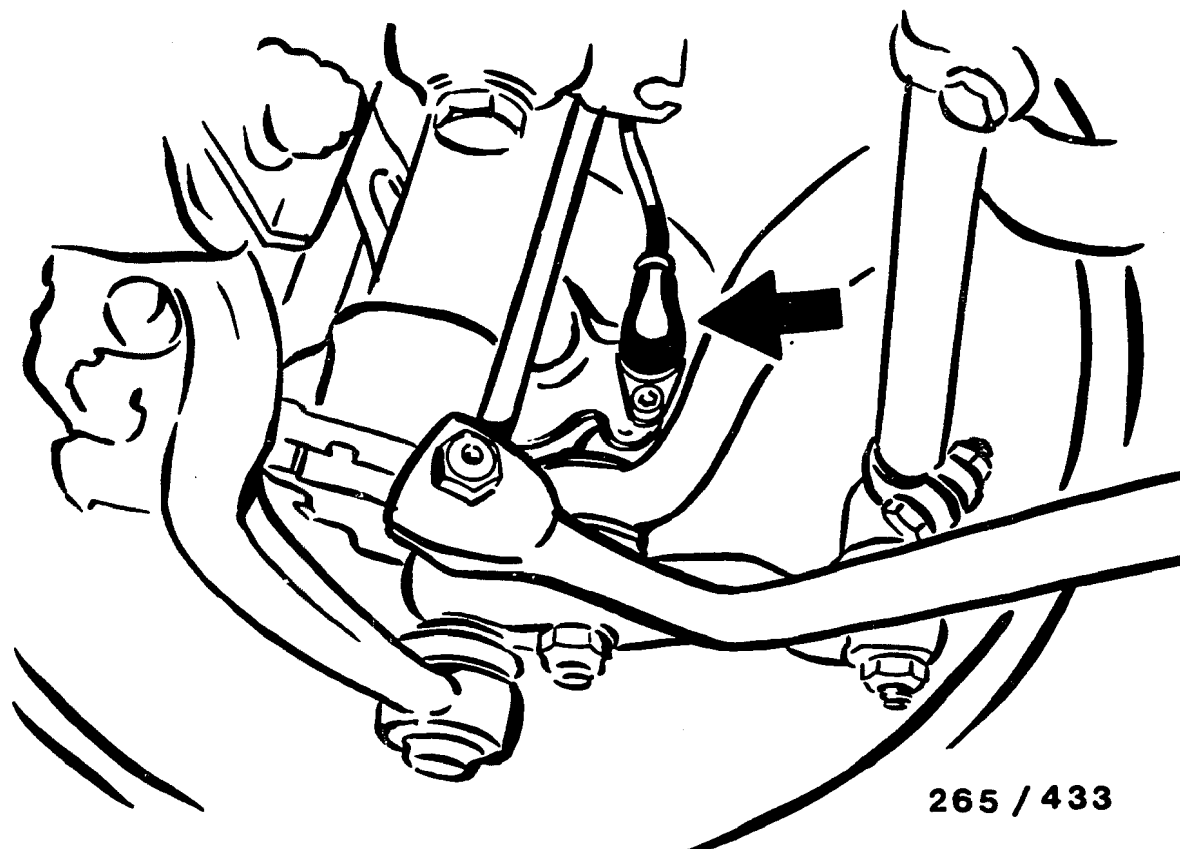


Arrow = Overvoltage-protection relay

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

##### Overvoltage-protection relay:

In the fuse and relay box. Relay box in the engine on the left in front of the firewall compartment.



Arrow = Engine-speed sensors, front

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

##### \* Hydraulic modulator:

730i, 735i:

In the engine compartment on the left-hand side in front of the brake master cylinder.

750i (L):

In the engine compartment behind the left-hand headlamp. The hydraulic modulator must not be repaired, but must be exchanged only as a complete unit.

Exception: The relays may be exchanged.

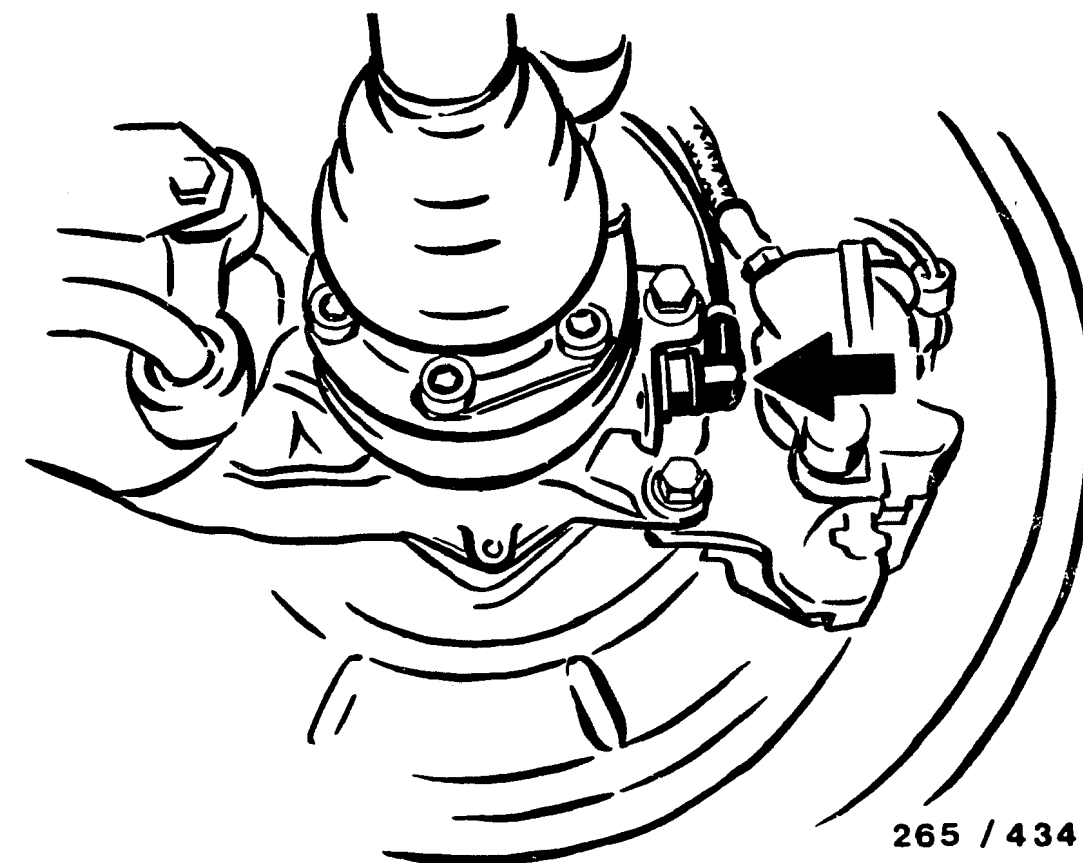
Make sure that the brake-line connections are not mixed up.

##### \* Wheel-speed sensors, front axle:

One on each side in the steering knuckles.

Wheel-speed-sensor plug-in connections:

In the engine compartment in the left and right wheel houses.



Arrow = Wheel-speed sensors, rear

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

##### \* Wheel-speed sensors, rear axle:

One on each side in the rear-axle trailing arm. To exchange, remove a wheel and loosen brake caliper.

Wheel-speed-sensor plug-in connections::

Behind the leadthroughs in the floor panel; that is, on the left and right beneath the rear seat bench.

Trouble-shooting instructions : BMW-5015

BOSCH system : ABS

Make of vehicle : BMW

Basic microcard : PKW-040

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Installation position of components, notes on removal and installation .....	23

SPECIAL FEATURES

This microcard contains the trouble-shooting instructions valid at the time of publication for the following models:

BMW 735 i (E 32), 8.87 ->  
BMW 750 i(L) (E 32), 9.87 ->

- \* ABS with ASR combined. One common ABS/ASR controller with 55-pin plug.
- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gear with 48 teeth.
- \* Note: Separate instructions have been compiled for the ASR unit.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 8 and term. 26.  
front right to term. 12 and term. 13/32 (750i).  
rear left to term. 29 and term. 30.  
rear right to term. 10 and term. 28.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!  
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.  
Repeat the complete test program after any repairs are carried out.  
The Antiskid System is a vehicle safety system.  
Work on the system demands detailed knowledge of the system.  
The conventional brake system must be O.K.

### General information for trouble-shooting:

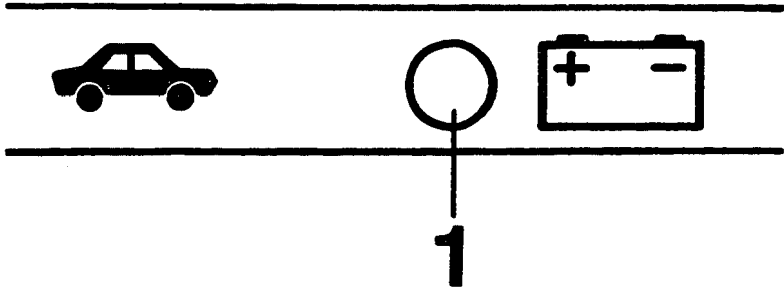
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

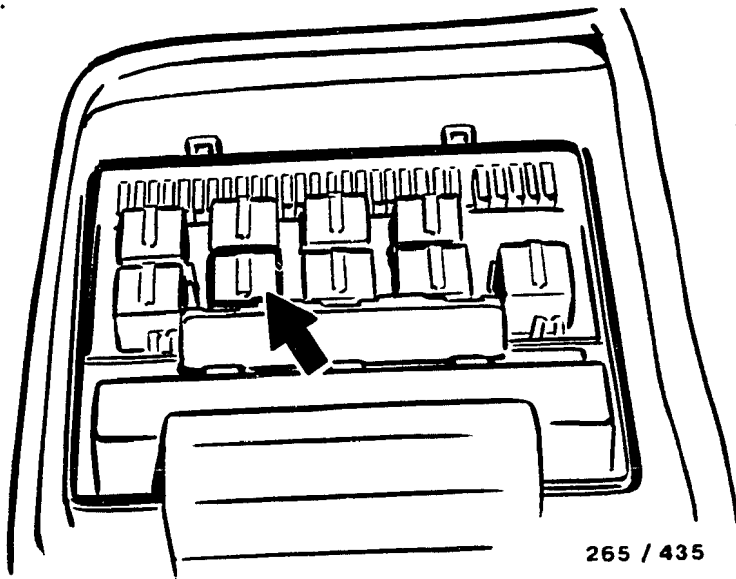
Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply  (term.1 und term.18)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none"><li>*Battery insufficiently charged</li><li>*High voltage drops</li><li>*Overvoltage-protection relay defective</li><li>*Check lead to ignition and starting switch, term. 15</li></ul>



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Arrow = Overvoltage-protection relay

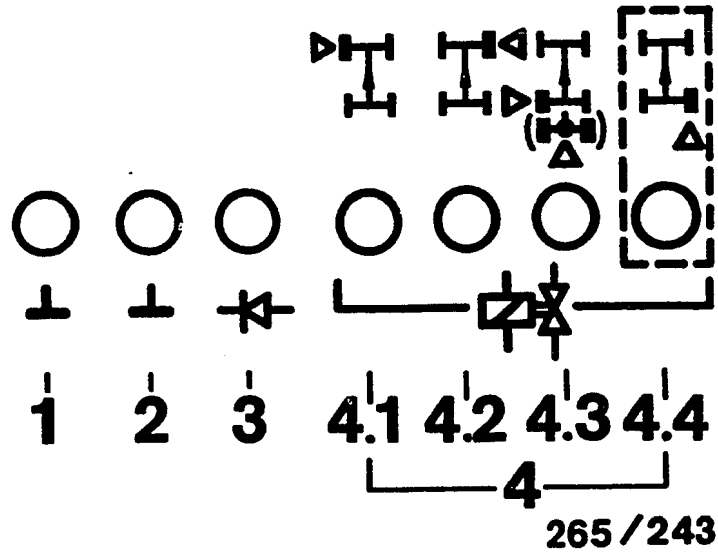


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RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.3, term.36)  Diode for warning lamp (term.4, term.6) Solenoid-operated valve internal res. (term.2, term.19, term.21, term.37)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.  Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>

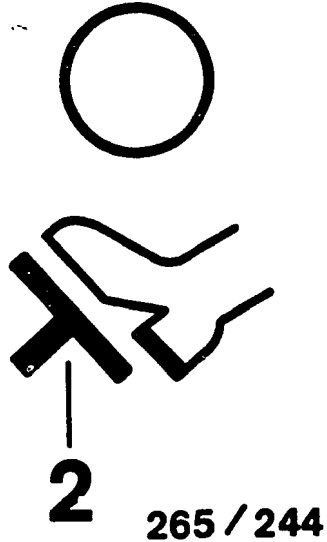




RAPID DIAGNOSIS CHART (CONTINUED)

Program switch setting 2

Testing of (measurement at terminals)	Addition- al operation	Test specifica- tion (indication)	Possible causes of fault
Alternator voltage of term.61 (term.33)	Ignition on	LED 1 (top picture) lights up.	* LED sometimes only goes out after accelerating (test is thus O.K.)
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead to alternator term.61  * Alternator defective.
Brake-light switch (term.15)	Ignition on	LED 2 (top picture) lights up	* Brake-light switch defective.  * Test lead to brake-light switch.
	Depress brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to brake-light switch.

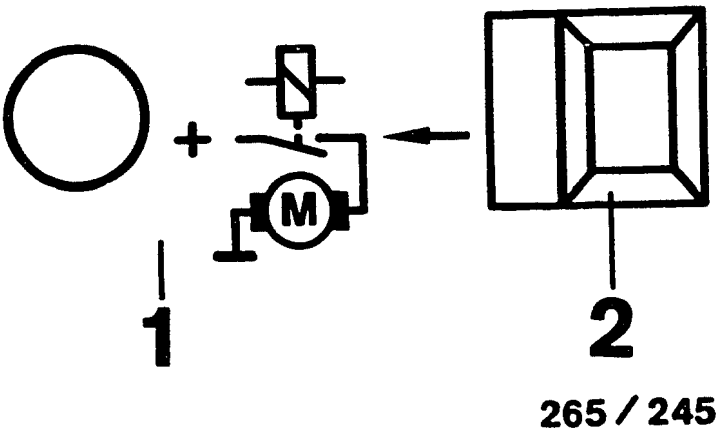


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RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 3

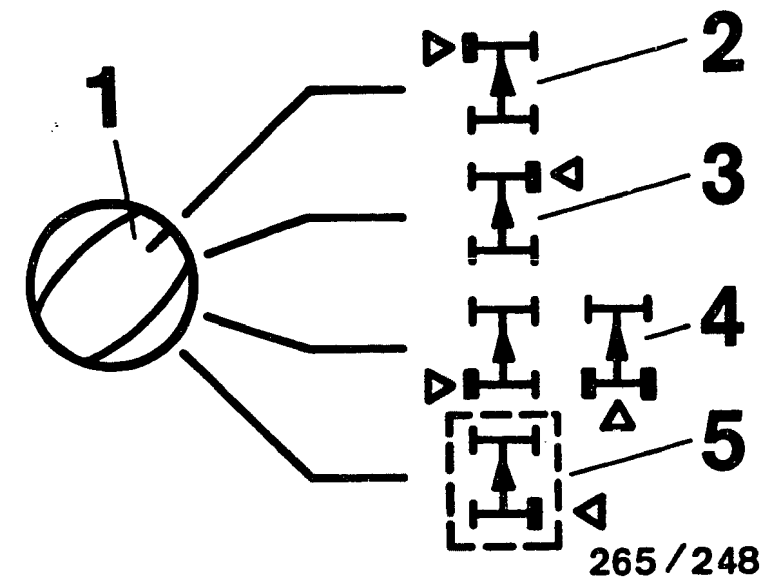
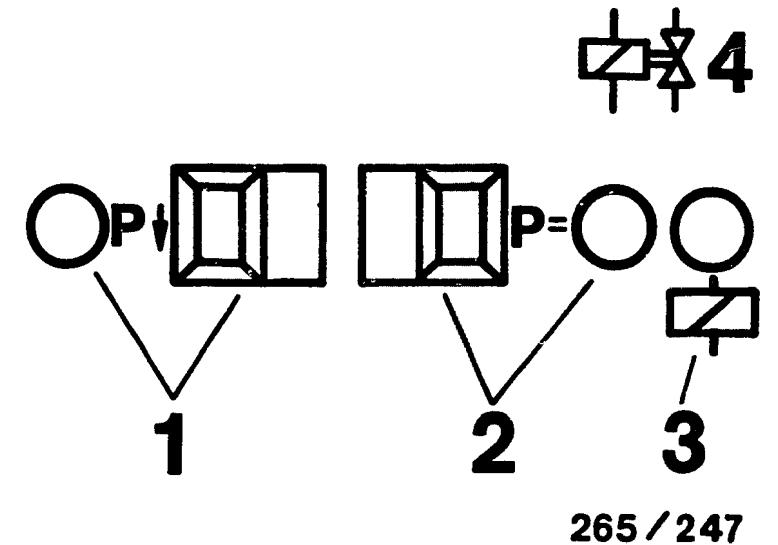
Under test (measurement at the term- inals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.5 and term.25)	Ignition on, keep push- button 2 constantly pressed (upper illus- tration)	LED 1 lights up, pump motor runs.  After the push- button has been released, LED stays lit due to running on (dieseling) of the engine (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor.</li><li>* Check following leads: from controller term.5 and term.25 to hydraulic modulator term.12 and check term.9. From controller term.20 to hydraulic modulator term.8 .</li><li>* Pump motor/hydraulic modulator defective.</li></ul>



Program-selector-switch position 4 not applicable.

RAPID DIAGNOSIS CHART (CONTINUED)  
Program switch setting 5 (4-channel hydraulic modulator)

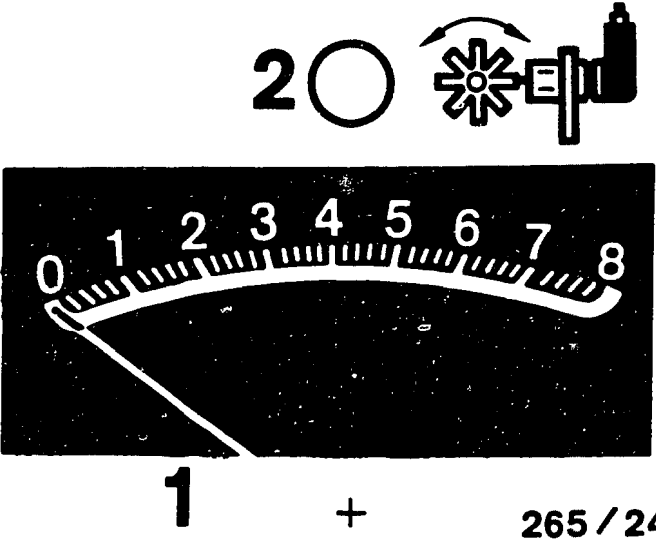
Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Valve relay function (term. 23)	Ignition on	LED 3 (top picture) lights up	* Valve relay (winding) or leads defective
Check solenoid valves in hydraulic modulator for proper functioning and mix-up. NOTE: Perform test consecutively for each individual wheel. Comply with operating sequence!	Check up vehicle. Ignition on. It must be possible to turn the wheel to be tested freely by hand. Set switch 1 for wheel selection to wheel to be tested (bottom picture).		* Repeat test with engine running  * Valve relay (make contact) defective  * Open-circuit in lead from valve relay, term. 87 to B+  * Brake lines mixed up at hydraulic modulator
Function Pressure retention	1. Press button P= (top picture) constantly	LED P= (top picture) lights up	* Current value is not attained (LED P arrow or P= off; top picture): Insufficient battery charge. Repeat test with engine running.
	2. Constantly depress brake pedal	Wheel can be turned by hand	
	3. Release button P= (top picture)	LED P= goes out (top picture) Wheel locks	
Function Pressure reduction	4. Press button P arrow (top picture)	LED P arrow (top picture) lights up, wheel can be turned by hand	* Proper electrical connection of solenoid valves? Front left wheel: term.21 Front right wheel: term.37 Rear left wheel: term.19 Rear right wheel: term. 2 Rear axle: term.-  * Hydraulic modulator defective
	5.Release button P arrow (top picture)	LED P arrow (top picture) goes out, wheel locks	
	6.Release brake pedal		



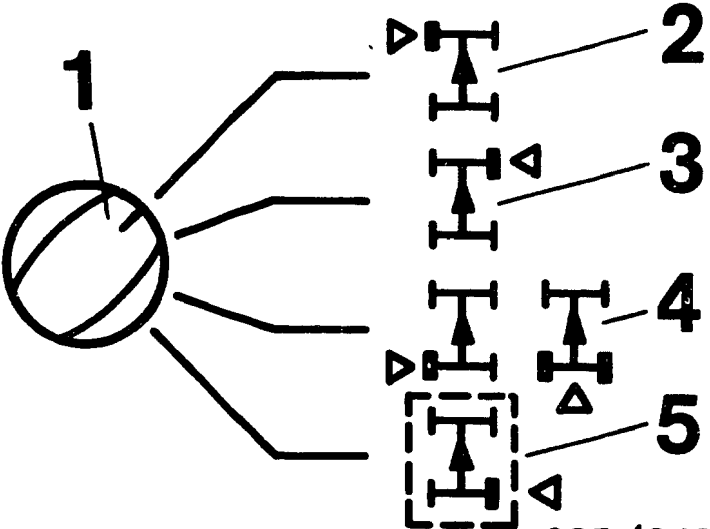
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term 8 and t.26</p> <p>Wheel, front right: term.12 and term.13/32</p> <p>Wheel, rear left: term.29 and term.30</p> <p>Wheel, rear right: term.10 and term.28</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1.6 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



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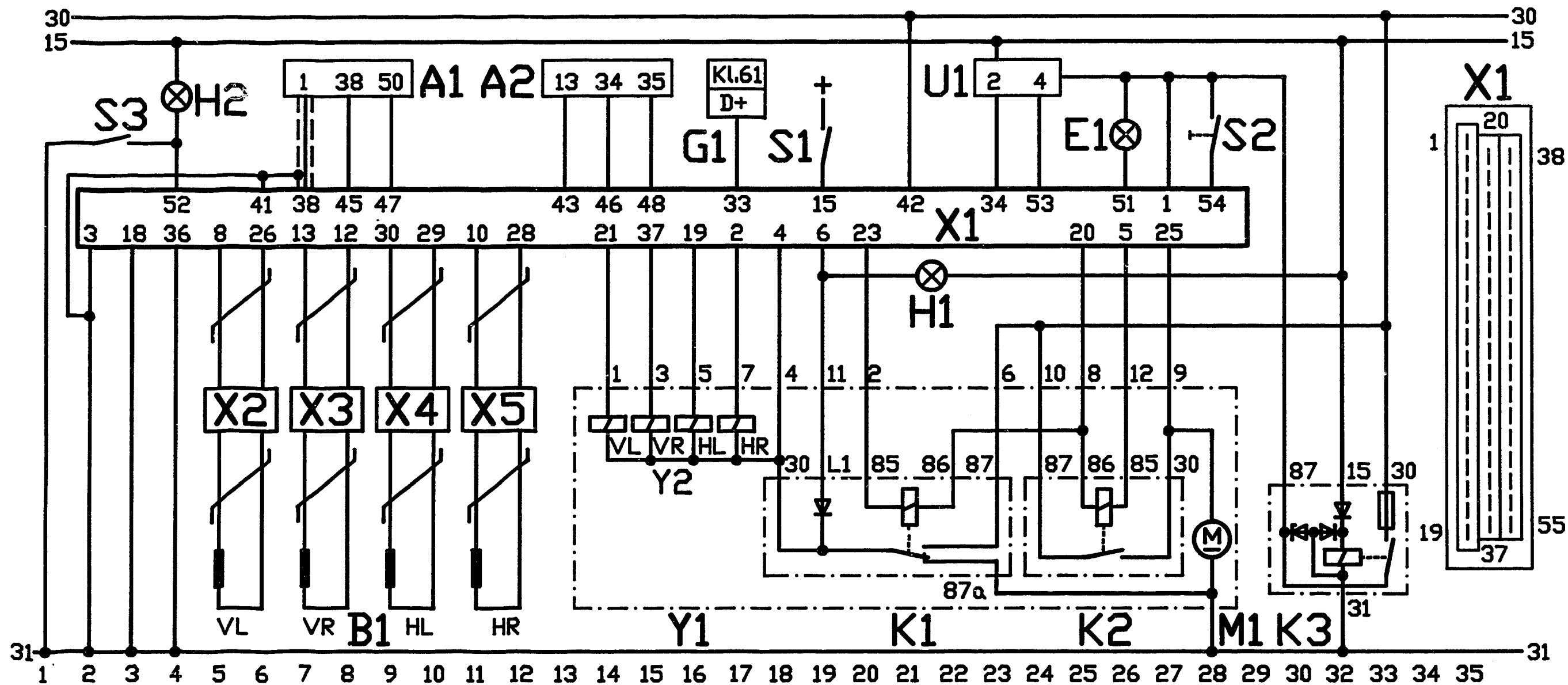


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TEST SPECIFICATIONS

Wheel-speed sensor		
* Winding resistance at ambient temperature (-10°C...+120°C) for		
Front axle:	600...1600	Ω
Rear axle:	600...1600	Ω
Hydraulic-modulator solenoid-operated valves		
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7	Ω
Air gap:	0,8±0,5	mm
Tightening torque for		
* Fastening screws of wheel-speed sensors:	> 8	Nm
* Brake-line connections on hydraulic modulator:	12...16	Nm
Number of teeth		
* Front axle:	48	teeth
* Rear axle:	48	teeth

For production reasons:  
continued on the following  
coordinate.



265/440

A1 = Motronic control unit  
 A2 = Electronic-accelerator control unit  
 B1 = Speed sensor  
 E1 = ASR indicator lamp  
 G1 = To alternator term. 61/D+  
 H1 = ABS warning lamp  
 H2 = Handbrake indicator lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Overvoltage-protection relay  
 M1 = Pump motor

S1 = Stop-lamp switch  
 S2 = ASR switch  
 S3 = Handbrake switch  
 U1 = Check control (blue plug)  
 X1 = ABS/ASR controller plug  
 X2, X3, X4, X5 = Speed-sensor plug  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves  
 HL, HR = rear left/right  
 VL, VR = front left/right  
 1 = for controller with blue nameplate

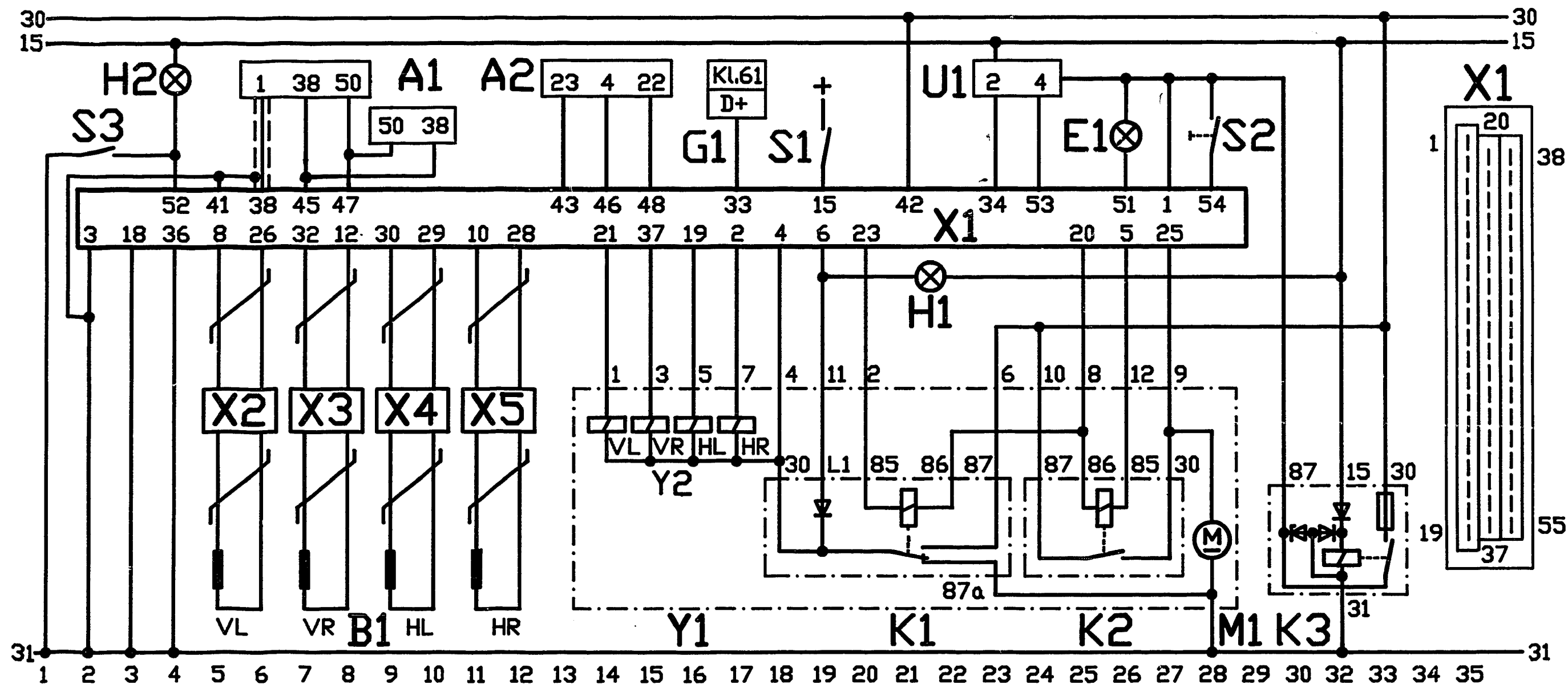
ELECTRICAL TERMINAL DIAGRAM BMW 735i, 8.87-→

F19

⇒

F20

⇐⇒



265/441

A1 = Motronic control units  
A2 = E Gas control unit  
B1 = Wheel-speed sensor  
E1 = ASR repeater lamp  
G1 = To alternator term. 61/D+  
H1 = ABS warning lamp  
H2 = Hand-brake indicator lamp  
K1 = Valve relay  
K2 = Motor relay  
K3 = Overvoltage-protection relay  
M1 = Pump motor

S1 = Stop-lamp switch  
S2 = ASR nonlocking switch  
S3 = Hand-brake switch  
U1 = Check Control (blue plug)  
X1 = ABS/ASR controller plug  
X2, X3, X4, X5 = Wheel-speed sensor plugs  
Y1 = Hydraulic modulator  
Y2 = Solenoid-operated valves  
HL, HR = Rear left, rear right  
VL, VR = Front left, front right

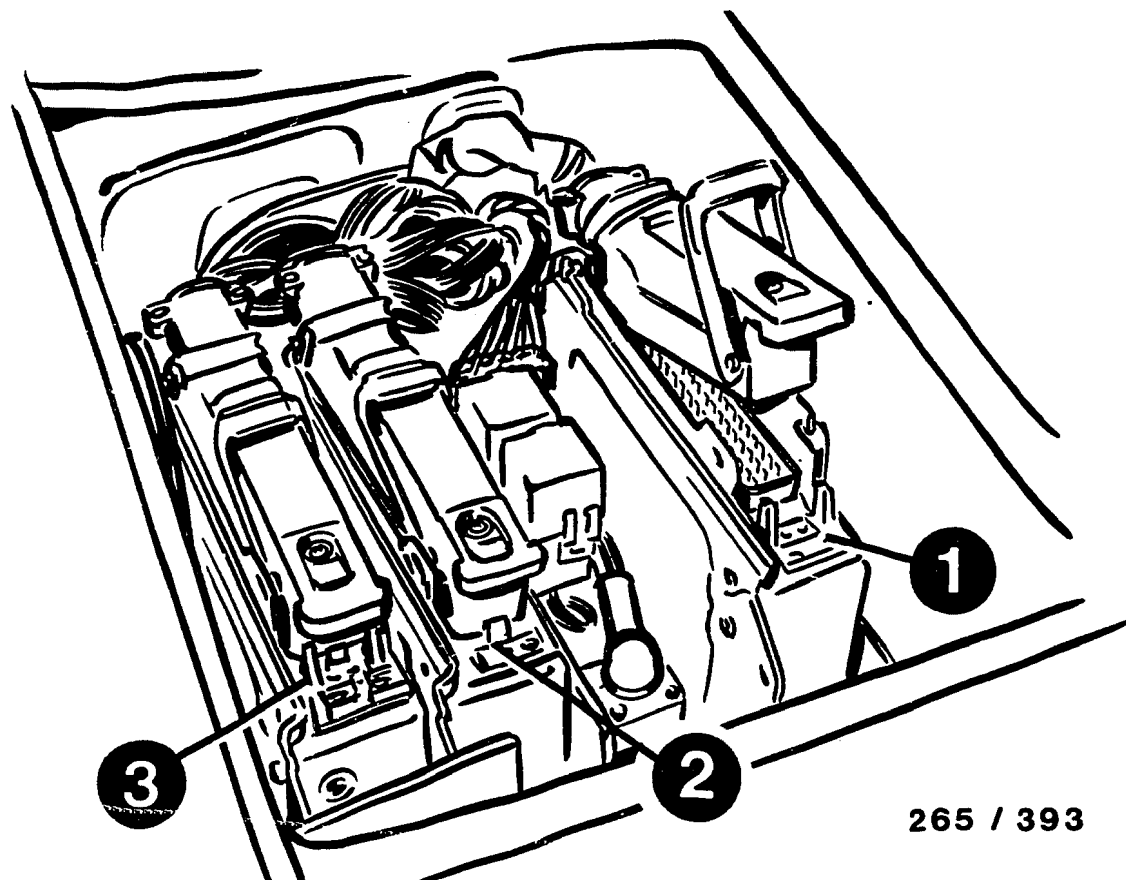
ELECTRICAL TERMINAL DIAGRAM BMW 750i(L) 09.87-→

F21

⇐⇒

F22

⇐⇒



265 / 393

- 1 = ABS/ASR controller
- 2 = E Gas control unit
- 3 = Motronic control unit in 735i.

#### INSTALLATION POSITION OF COMPONENTS

- \* ABS/ASR controller (Item 1):  
In the engine compartment beneath the engine hood.  
Remove cover.  
Pull off plug:  
Lift up unlatching clip and unhook plug  
on wiring-harness end from mechanical  
encoder.
- \* ABS warning lamp:  
In the instrument cluster.  
Labelled: ABS.
- \* Ground terminal:  
In the engine compartment on the control-  
unit box on the left beneath a cover.



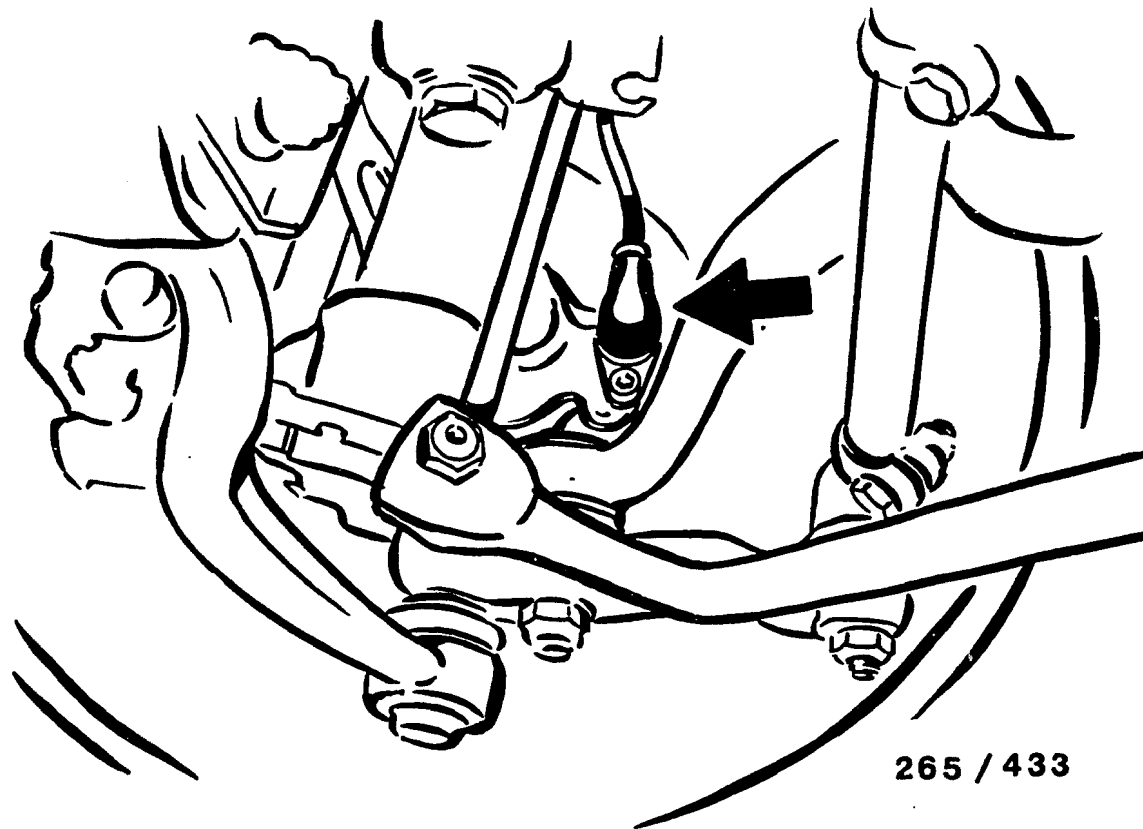
265 / 435

- 1 = Overvoltage-protection relay

#### INSTALLATION POSITION OF COMPONENTS (Continued)

Overvoltage-protection relay:  
In the fuse and relay box. Relay box in the engine  
compartment on the left-hand side in front of the  
firewall.





Arrow = Engine-speed sensors, front

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

##### \* Hydraulic modulator:

7301, 7351:

In the engine compartment on the left-hand side in front of the brake master cylinder.

7501 (L):

In the engine compartment behind the left-hand headlamp. The hydraulic modulator must not be repaired, but must be exchanged only as a complete unit.

Exception: The relays may be exchanged.

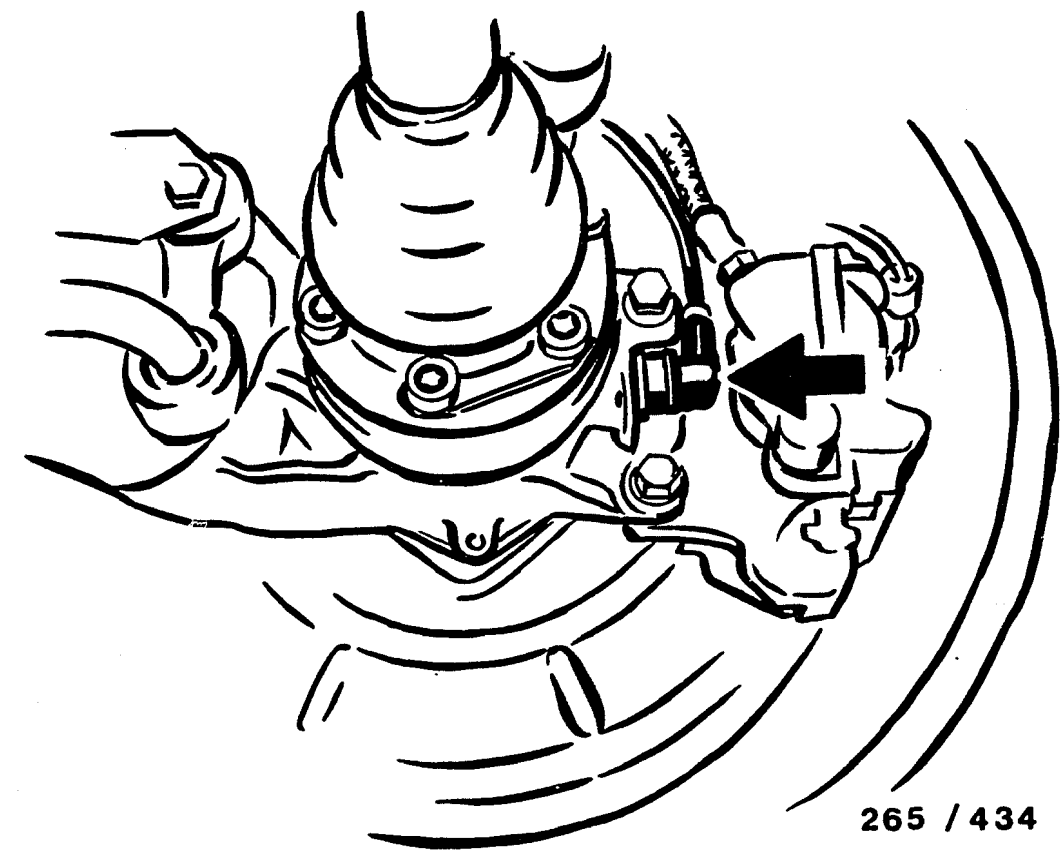
Make sure that the brake-line connections are not mixed up.

##### \* Wheel-speed sensors, front axle:

One on each side in the steering knuckles.

Wheel-speed-sensor plug-in connections:

In the engine compartment in the left and right wheel houses.



Arrow = Wheel-speed sensors, rear

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

##### \* Wheel-speed sensors, rear axle:

One on each side in the rear-axle trailing arm. To exchange, remove a wheel and loosen brake caliper.

Wheel-speed-sensor plug-in connections::

Behind the leadthroughs in the floor panel; that is, on the left and right beneath the rear seat bench.

Trouble-shooting instructions : BMW-5020  
BOSCH system : ABS  
Make of vehicle : BMW  
Basic microcard : PKW-040

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Electrical terminal diagram .....	19
Installation position of components, notes on removal and installation .....	21

SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

BMW 5 Series (E 34) 1.1988->

- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gears with 48 teeth.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

## TEST PREREQUISITES WHEN USING ABS2-LED TESTER

- \* Correct tire size fitted?
- \* Check tightness of return-pump ground connection.
- \* Check tightness of ground strap between engine block and vehicle frame.
- \* Check hydraulic connections at hydraulic modulator and sealing points for leaks (visual inspection).
- \* If the ABS warning lamp lights up from time to time when driving (e.g. after switching on loads) and goes out again of its own accord, check battery and voltage supply (alternator, regulator and voltage dips).
- \* If ABS warning lamp lights up continuously and does not go out, check the following:
  - Is controller plug properly seated on controller and is it engaged?
  - All plug contacts O.K.?
  - Spring contacts engaged?
  - Check installation position of sealing ring in controller plug to ensure proper fit: curvature downwards.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 7 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

### General information for trouble-shooting:

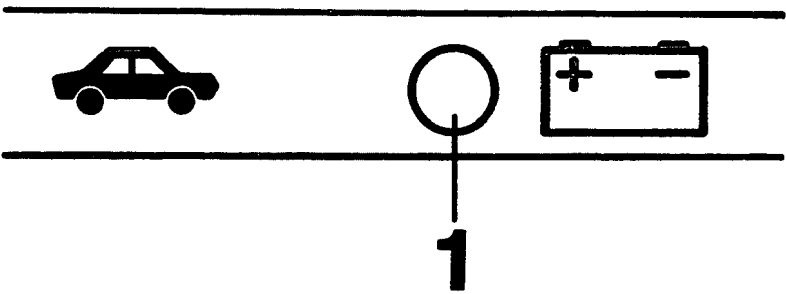
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been fulfilled?

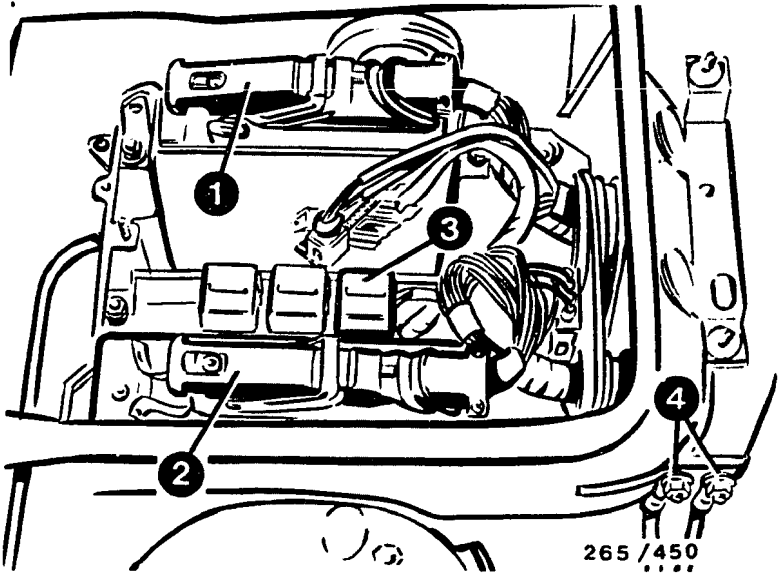
Program-selector-switch settings 1 - 6

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (Term. 1 and term.20)	Ignition on	LED 1 (top picture) lights up continuously	<ul style="list-style-type: none"><li>* Insufficient battery charge</li><li>* Excessive voltage dips at ground and positive leads.</li><li>* Check plug connections.</li><li>* Check lead to Motronic relay, term. 87.</li><li>* Motronic relay defective.</li></ul>



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- 1 = Motronic control unit
- 2 = ABS controller
- 3 = Motronic relay
- 4 = Ground terminals

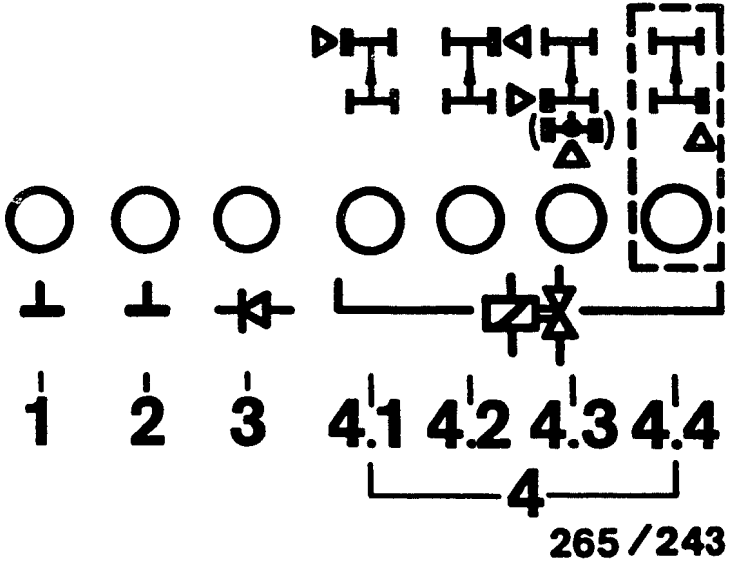


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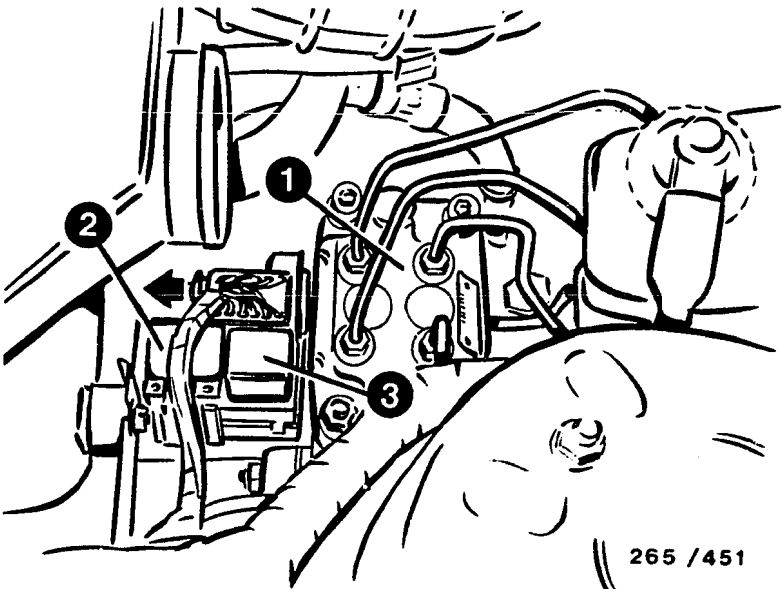
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term. 2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.</li></ul> <p>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></p> <ul style="list-style-type: none"><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

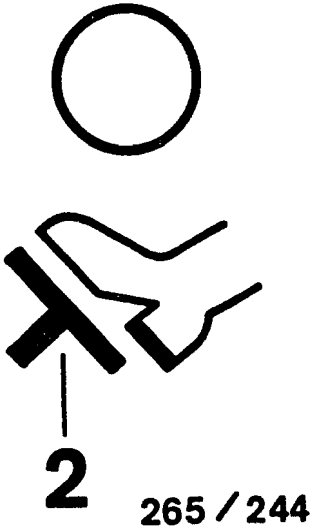


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RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

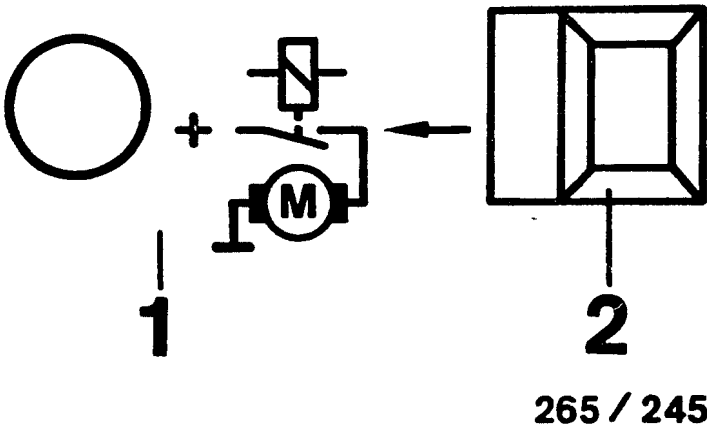
Under test (Measurement at the terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



RAPID DIAGNOSIS CHART (CONTINUED)

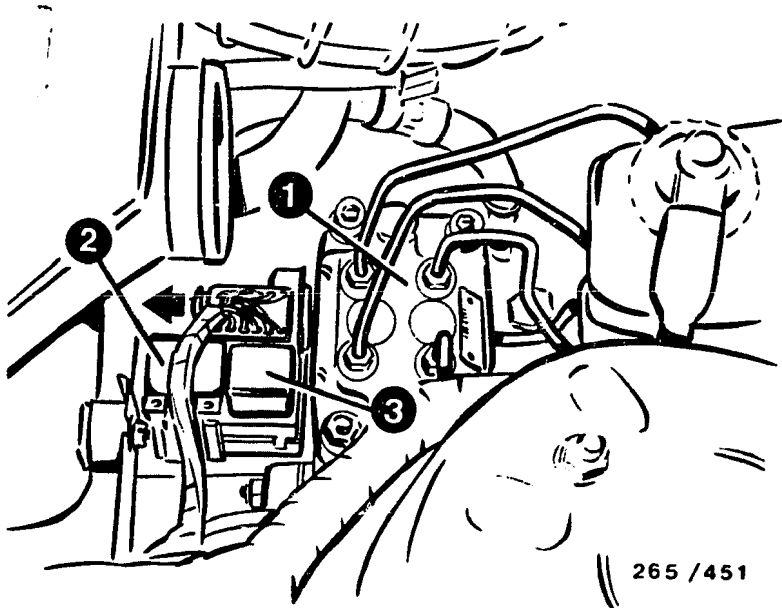
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 12. Positive lead to hydraulic modulator term. 8.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



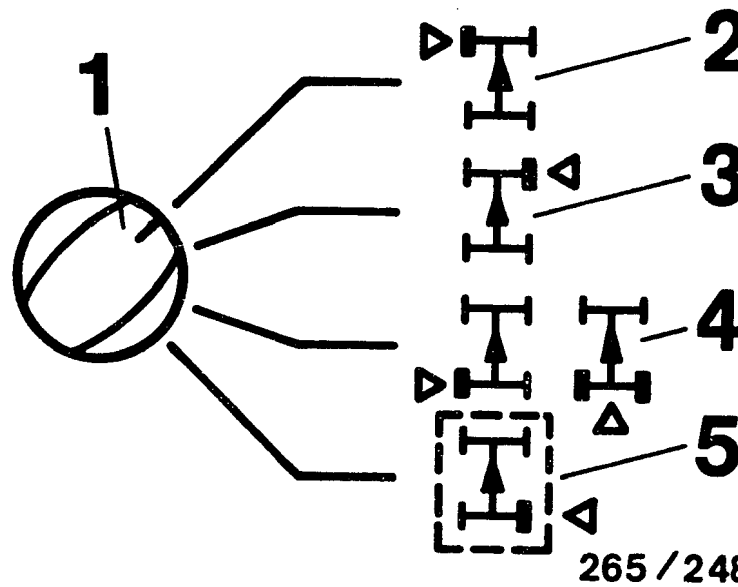
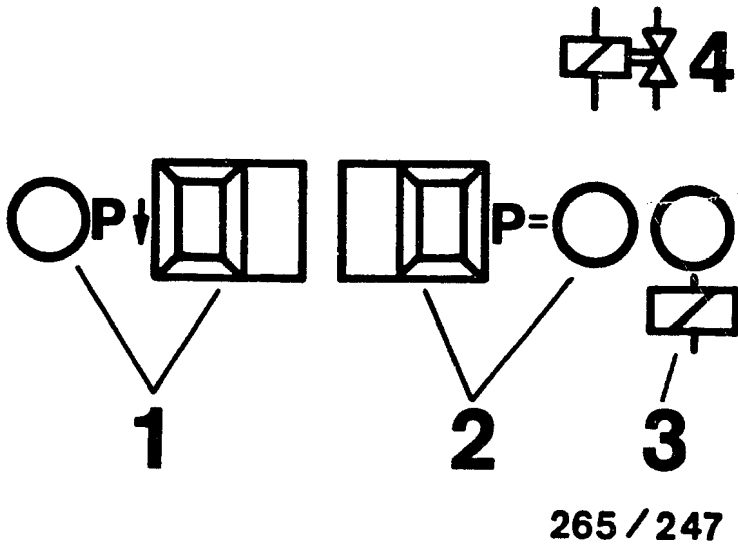
Program-selector-switch position 4 not applicable.

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (4-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay oper- ation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydr- aulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+  * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push- button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel,front left: term. 2 Wheel,front right: term.35 Wheel,rear left: term.18 Wheel,rear right: term.19 Rear axle: term. -  * Hydraulic modulator defective
	5.Release push- button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6.Release brake pedal		

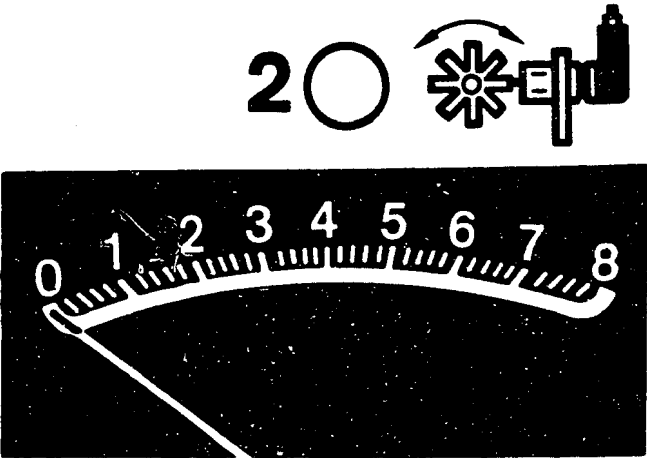




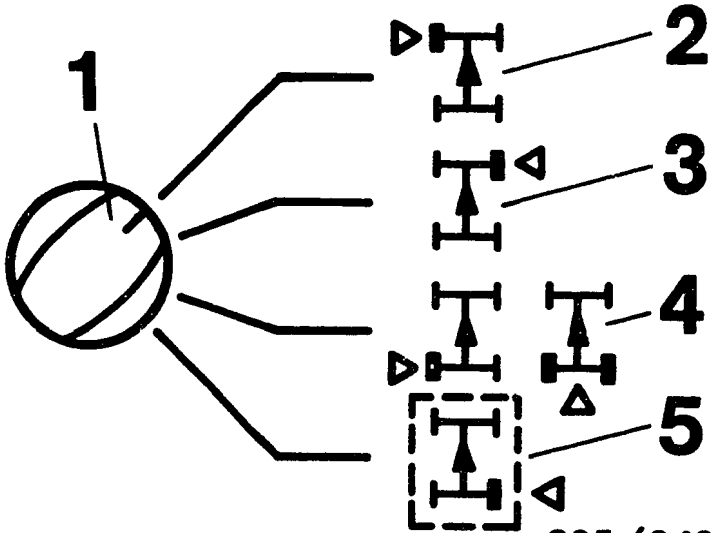
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and t.6</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,6 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



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# TEST SPECIFICATIONS

## Wheel-speed sensor

* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:	600...1600 $\Omega$
rear wheels:	600...1600 $\Omega$

## Hydraulic-modulator solenoid valves

* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7 $\Omega$
---	--------------------

## Air gap between wheel-speed sensor and ring gear

* at front wheels:	0,8 $\pm$ 0,5 mm
* at rear wheels:	0,8 $\pm$ 0,5 mm

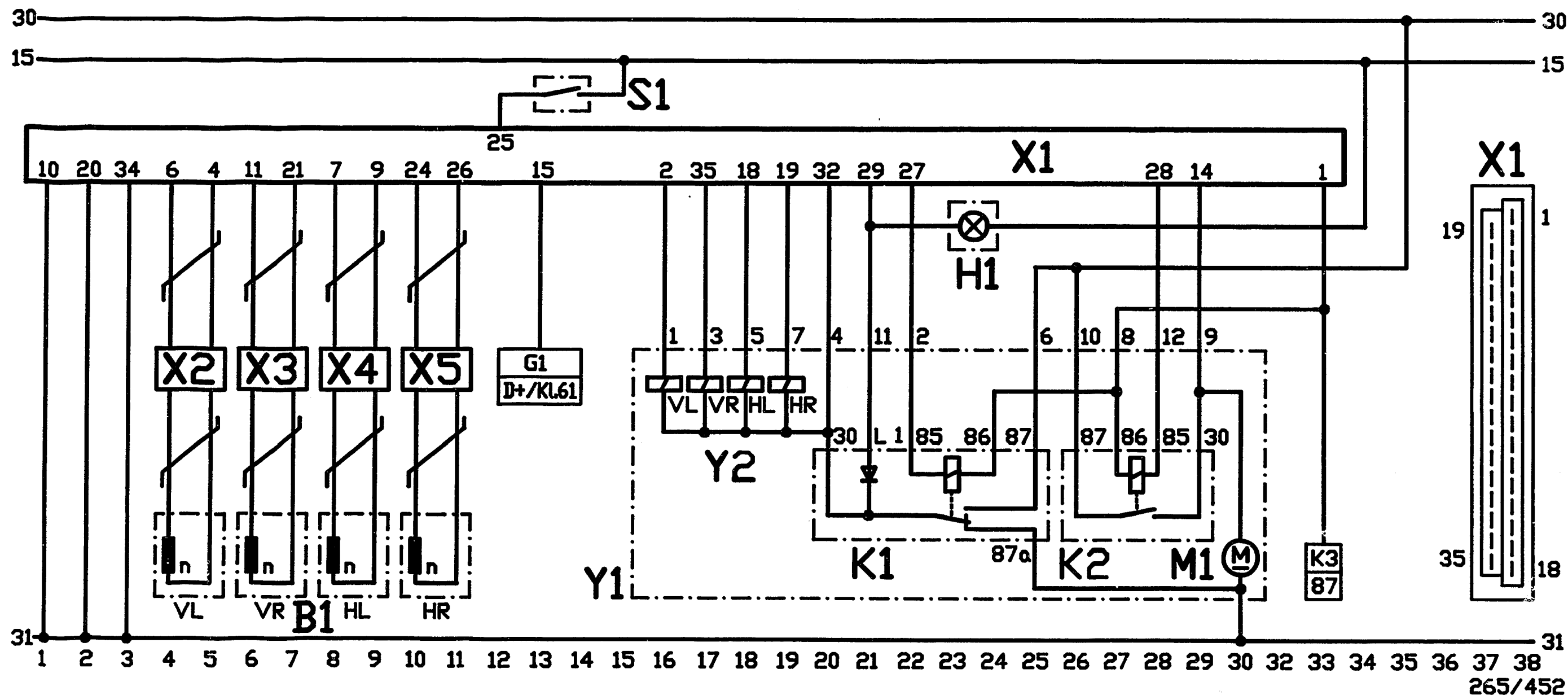
## Tightening torque for

* fastening screws of wheel-speed sensors:	> 8 Nm
* Brake-line connections at hydraulic modulator:	12...16 Nm

## Number of teeth on ring gears of wheel-speed sensors

* at front wheels:	48 teeth
* at rear wheels:	48 teeth

For production reasons:  
continued on the following  
coordinate.



B1 = Wheel-speed sensor  
 G1 = To alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Engine relay  
 K3 = Motronic relay

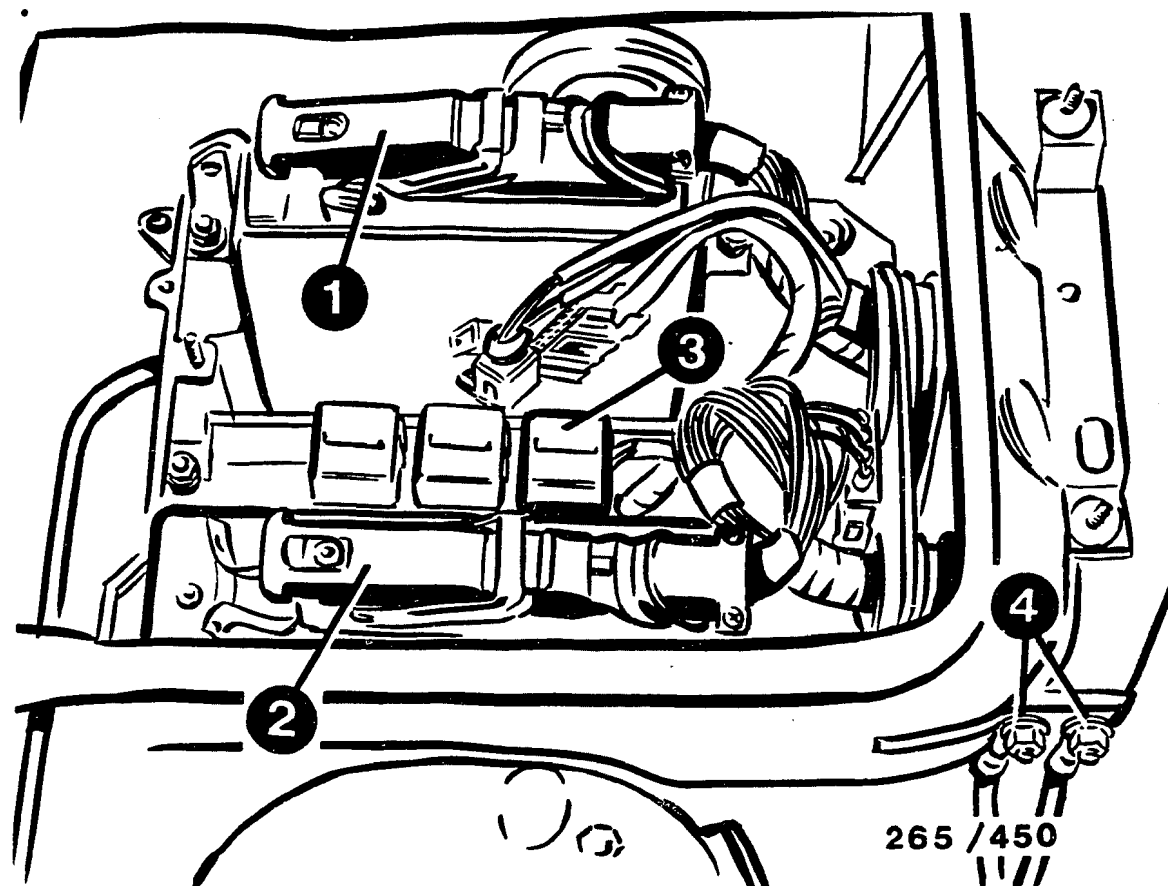
M1 = Return pump motor  
 S1 = Brake-light switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Wheel-speed-sensor plug  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right

ELECTRICAL TERMINAL DIAGRAM (1.1988 ->)

G19 —————>

G20 —————<=

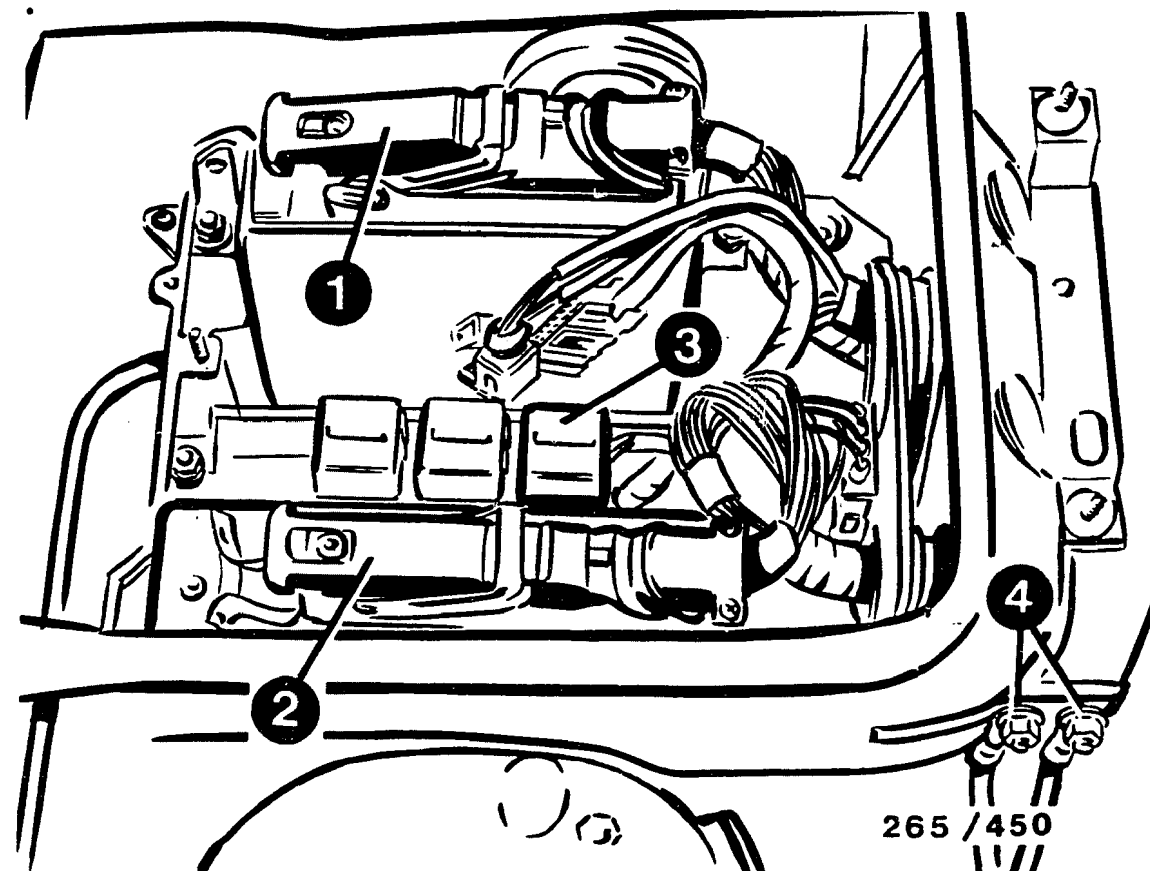


- 1 = Motronic control unit
- 2 = ABS controller
- 3 = Motronic relay
- 4 = Ground terminals

#### INSTALLATION POSITION OF COMPONENTS

The information given on installation locations is always referenced to the direction of travel.

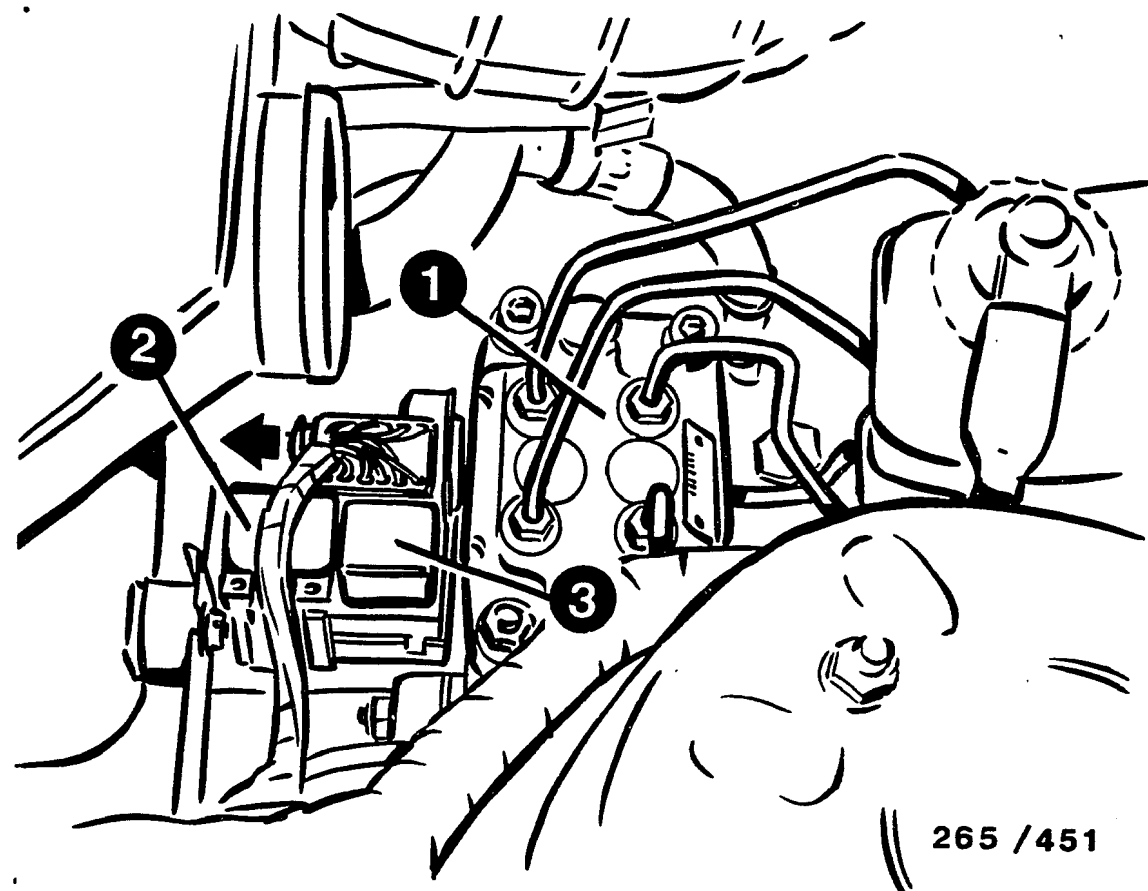
- \* ABS controller:  
In equipment compartment beneath hood, right.  
Unscrew cover.  
Detach plug:  
Raise unlocking bracket/press back spring  
and disconnect wiring-harness end of plug from  
mechanical coding.
- \* ABS warning lamp:  
In instrument cluster.  
Labelled: ABS.



- 1 = Motronic control unit
- 2 = ABS controller
- 3 = Motronic relay
- 4 = Ground terminals

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Over-voltage protection relay:  
An over-voltage protection relay is no longer fitted. The over-voltage protection is located in the controller (Z-diode) and the supply of power is assumed by the Motronic relay.
- \* Ground terminal:  
In engine compartment at control-unit box, left beneath a cover.

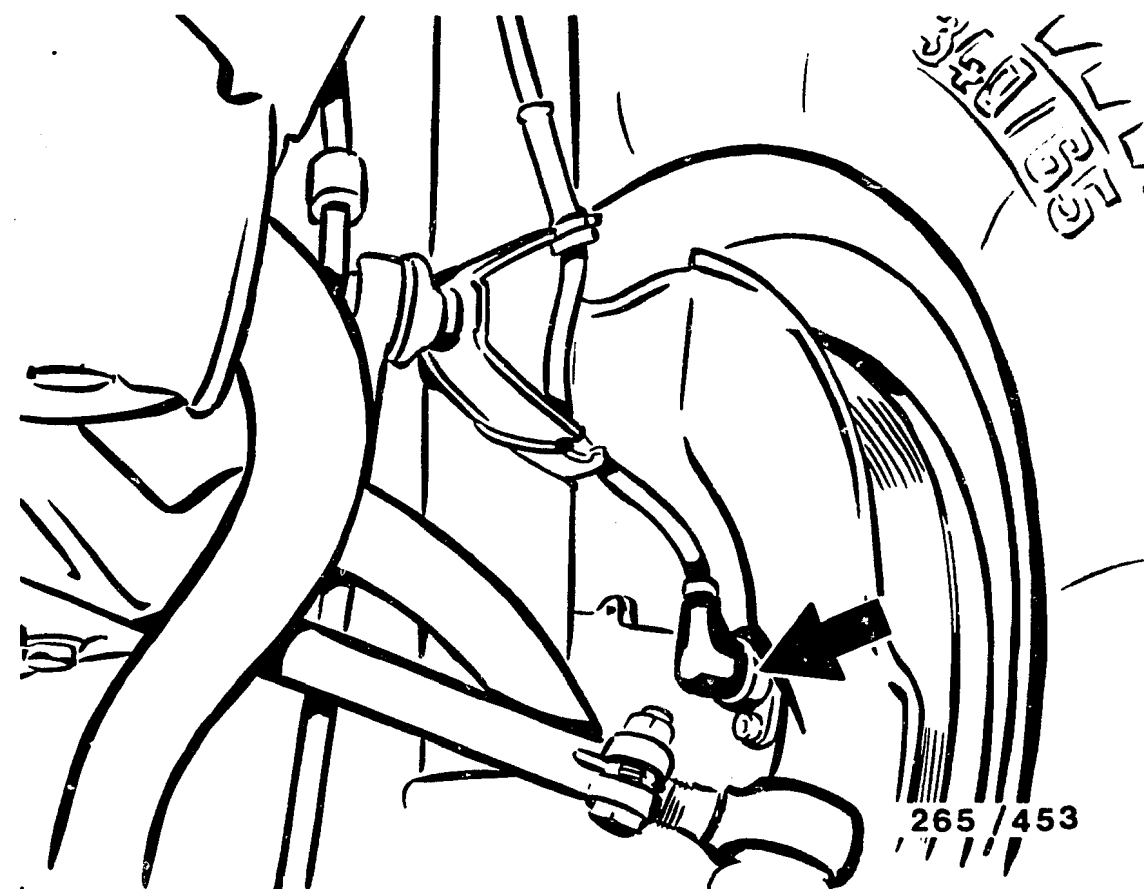


- 1 = Hydraulic modulator  
 2 = Engine relay  
 3 = Valve relay  
 Arrow = Plug locking mechanism

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Hydraulic modulator:  
 In engine compartment, left ahead of brake master cylinder.
- The hydraulic modulator is not to be repaired, but rather replaced as a complete assembly.  
 Exception: relay change.  
 To remove plug, detach plug locking mechanism in direction of arrow. To fit, press locking mechanism back again.

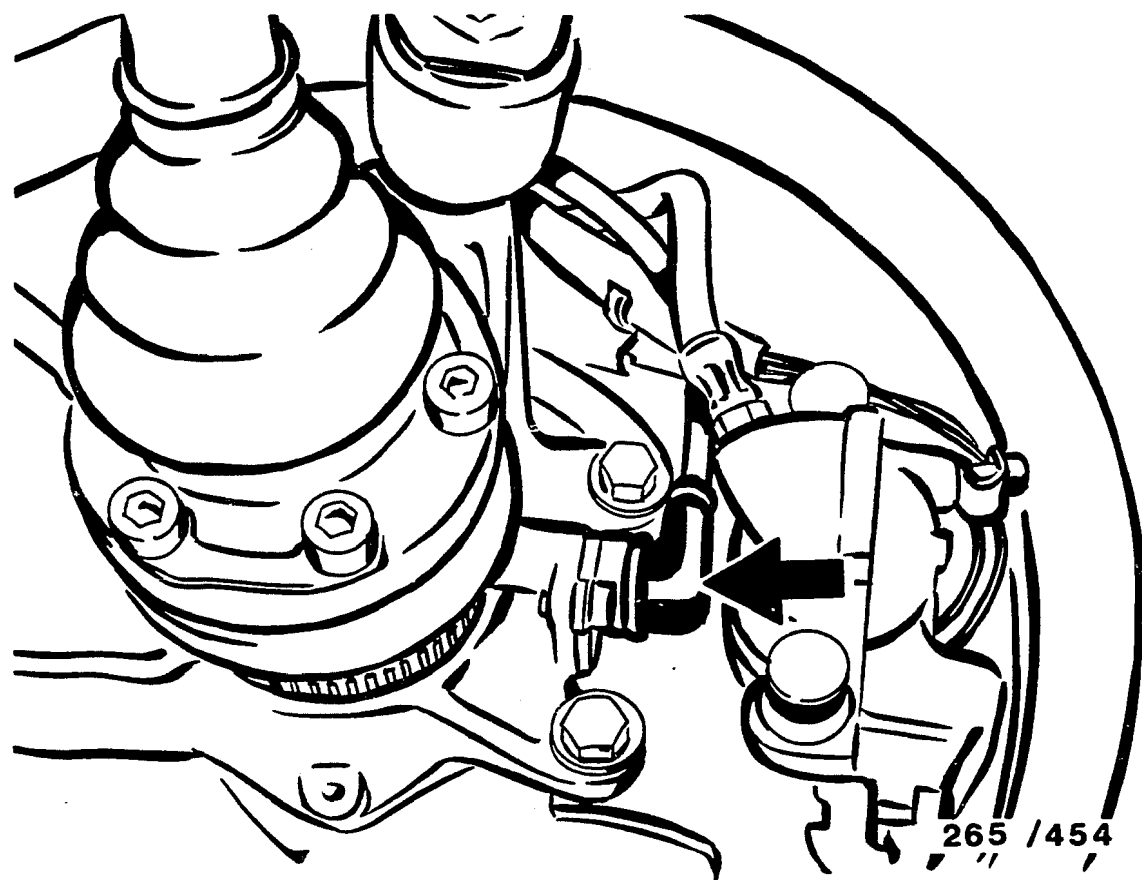
Pay attention to correct assignment of brake-line connections.



Arrow = Wheel-speed sensor, front

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Wheel-speed sensor, front axle:  
 One sensor each on the left and right in steering knuckles.  
 Wheel-speed-sensor plug connections:  
 In engine compartment on left and right at wheel arch, roughly in center.



Arrow = Wheel-speed sensor, rear

#### INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Wheel-speed sensor, rear axle:  
One sensor each on left and right in rear-axle link.  
To replace, remove wheel and detach brake caliper.

#### Wheel-speed-sensor plug connections:

Beneath rear seat bench on left and right.  
Important! Do not damage rubber sleeve in floor plate when pulling through plug connection.

For production reasons:  
continued on the following  
coordinate.

Trouble-shooting instructions : BMW-5026

BOSCH system : ABS

Make of vehicle : BMW

Basic microcard : PKW-040

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Installation position of components, notes on removal and installation .....	21

SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

BMW 318i,320i,325i, 325e,324td  
09.1987->

- \* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- \* Sensor ring gear with 48 teeth.
- \* As of 9.88 the ABS voltage supply for vehicles with petrol engines is tapped from the Motronic relay term. 87.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 8 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

### General information for trouble-shooting:

Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

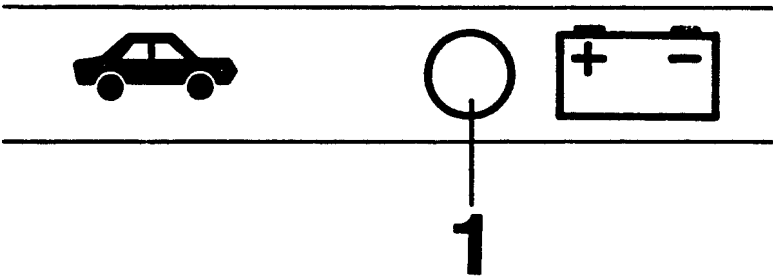


RAPID DIAGNOSIS CHART

Never drive with tester connected ! Have all test prerequisites been satisfied?

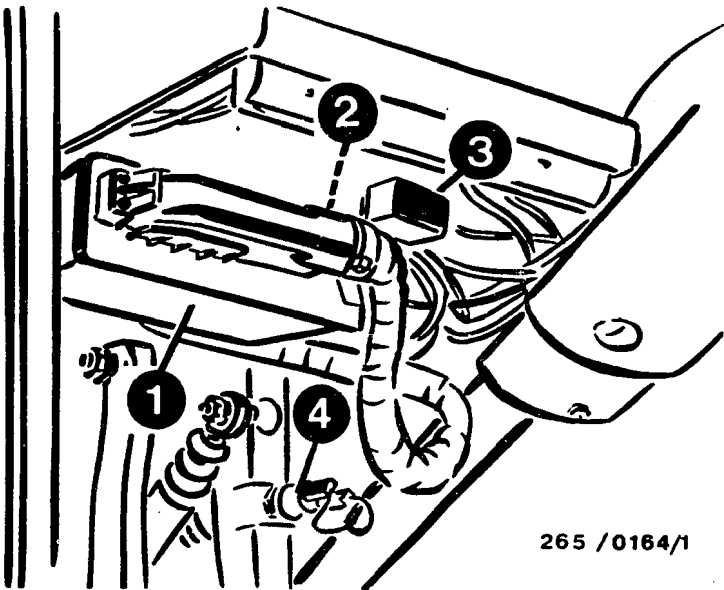
Program-selector switch setting 1 - 6

Test of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of trouble
Voltage supply  (Term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up continuously	<ul style="list-style-type: none"><li>* Battery insufficiently charged.</li><li>* Voltage dips too high.</li><li>* Test leads from relay plug to controller at term. 1, to driving switch term. 15 and to ground terminal.</li><li>* Over-voltage protection relay or Motronic relay defective.</li></ul>



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- 1 = ABS controller
- 2 = Ground terminal
- 3 = Over-voltage protection relay
- 4 = Stop-lamp switch

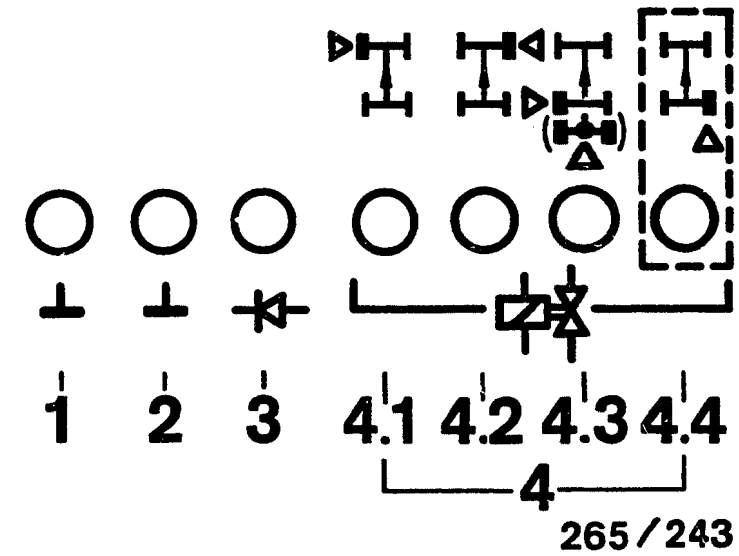


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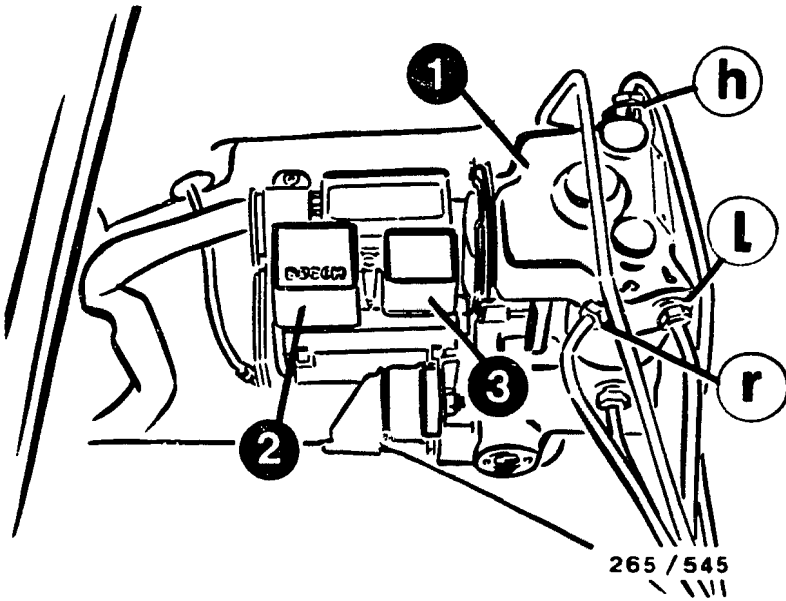
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.35, term.-)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 5 LEDs lit.</li></ul>



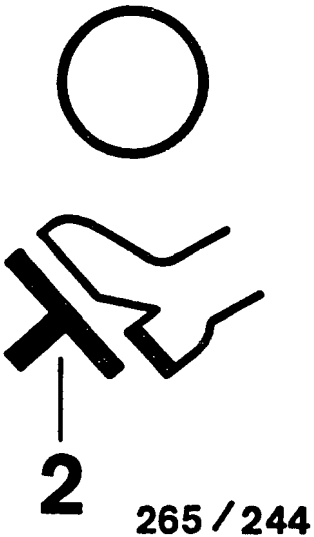
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61/D+  * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

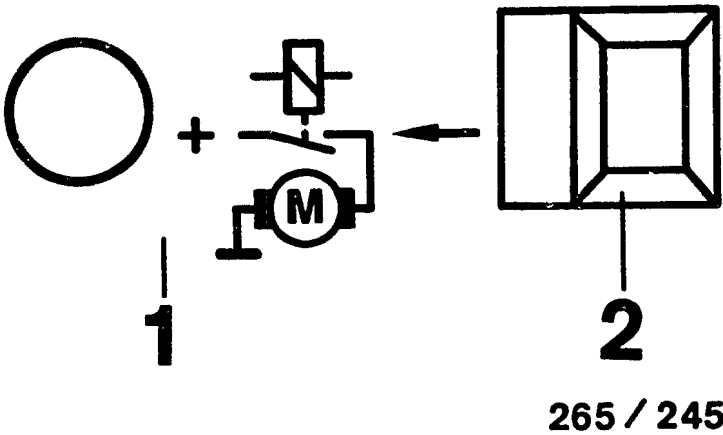


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RAPID DIAGNOSIS CHART (CONTINUED)

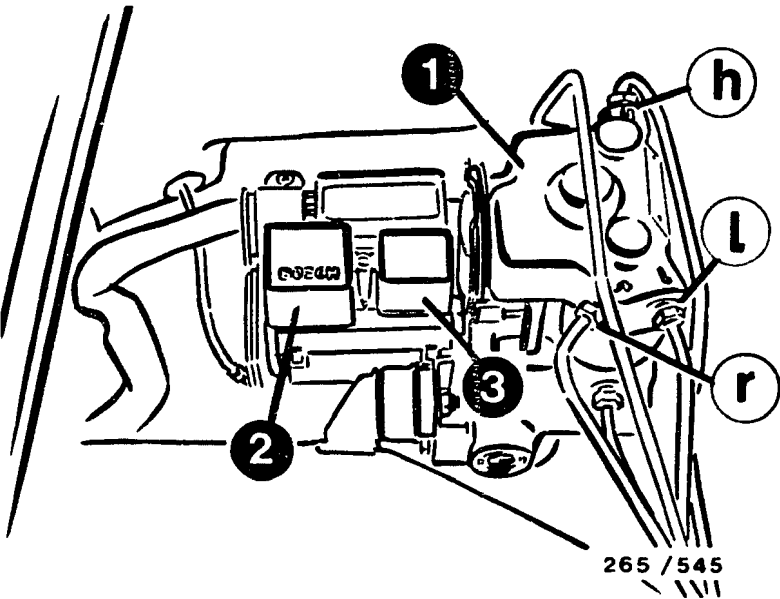
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs.  After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Test ground connection and positive terminal of pump motor</li><li>* Test following leads:  From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 10 and term. 12.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



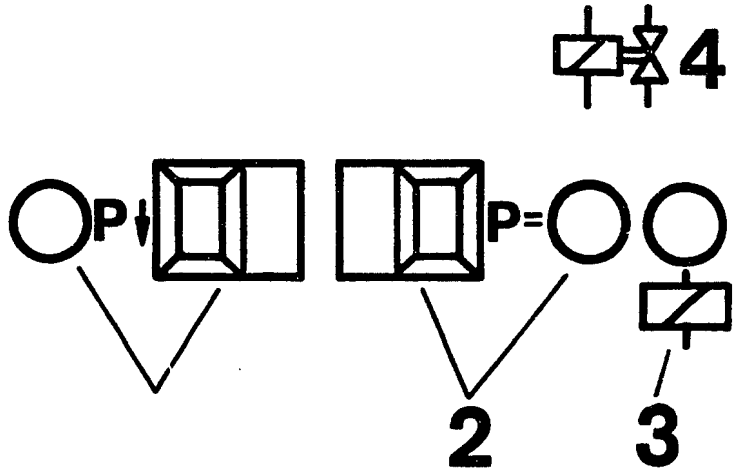
Program-selector-switch position 4 does not apply.

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

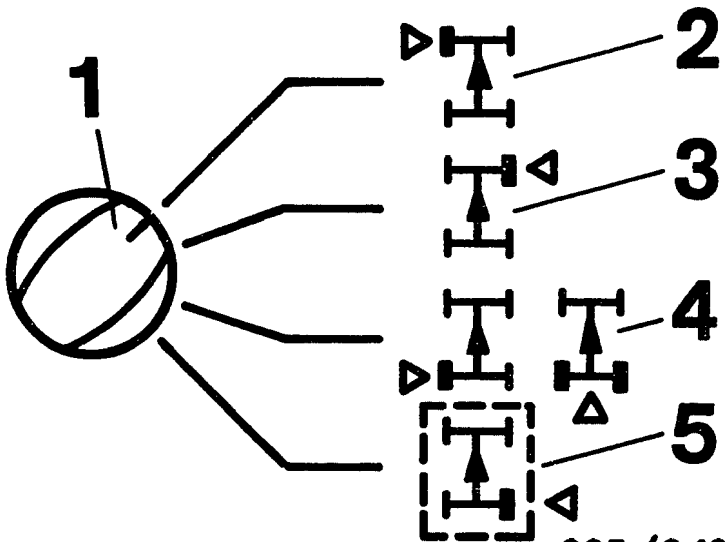


RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (3-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay oper- ation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydr- aulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push- button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term. 35 Wheel, rear left: term. - Wheel, rear right: term. - Rear axle: term. 18  * Hydraulic modulator defective
	5. Release push- button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



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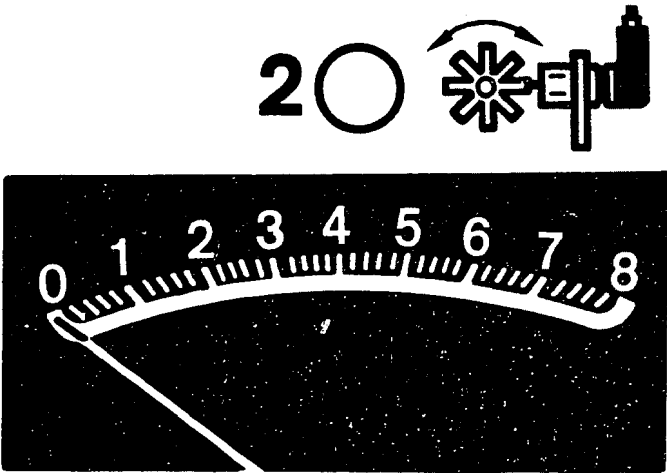


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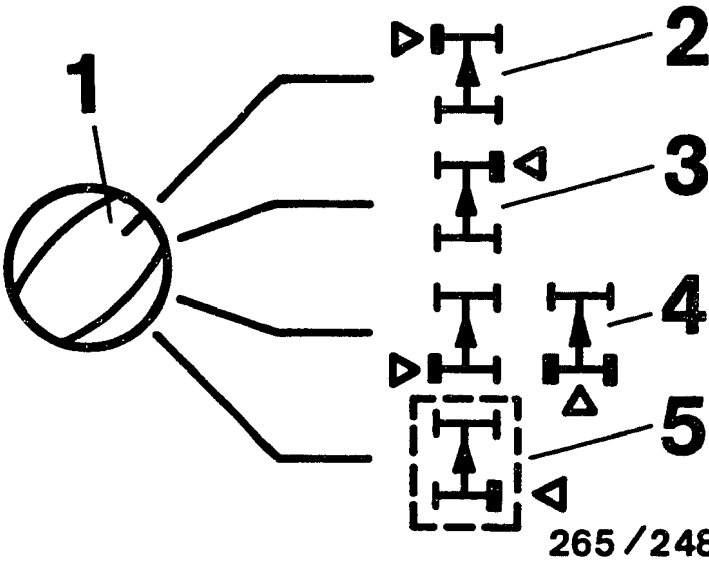
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term4 and t.6</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.8 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,6 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



1 + 265 / 249



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# TEST SPECIFICATIONS

## Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:
- rear wheels:

600...1600 Ω  
600...1600 Ω

## Hydraulic-modulator solenoid valves

- \* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7 Ω

## Air gap between wheel-speed sensor and ring gear

- \* at front wheels:
- \* at rear wheels:

0,8 ± 0,5 mm  
0,8 ± 0,5 mm

## Tightening torque for

- \* fastening screws of wheel-speed sensors:

> 8 Nm

- \* Brake-line connections at hydraulic modulator:

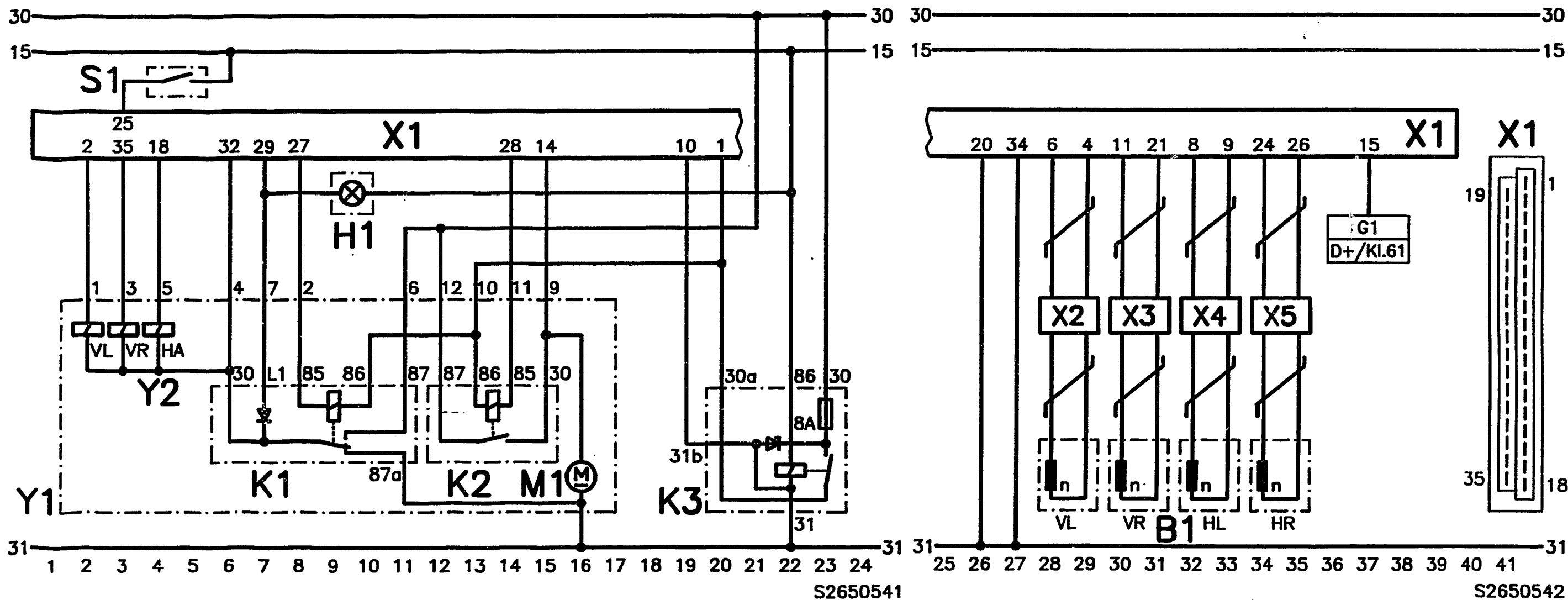
12...16 Nm

## Number of teeth on ring gears of wheel-speed sensors

- \* at front wheels:
- \* at rear wheels:

48 teeth  
48 teeth

For production reasons:  
continued on the following  
coordinate.



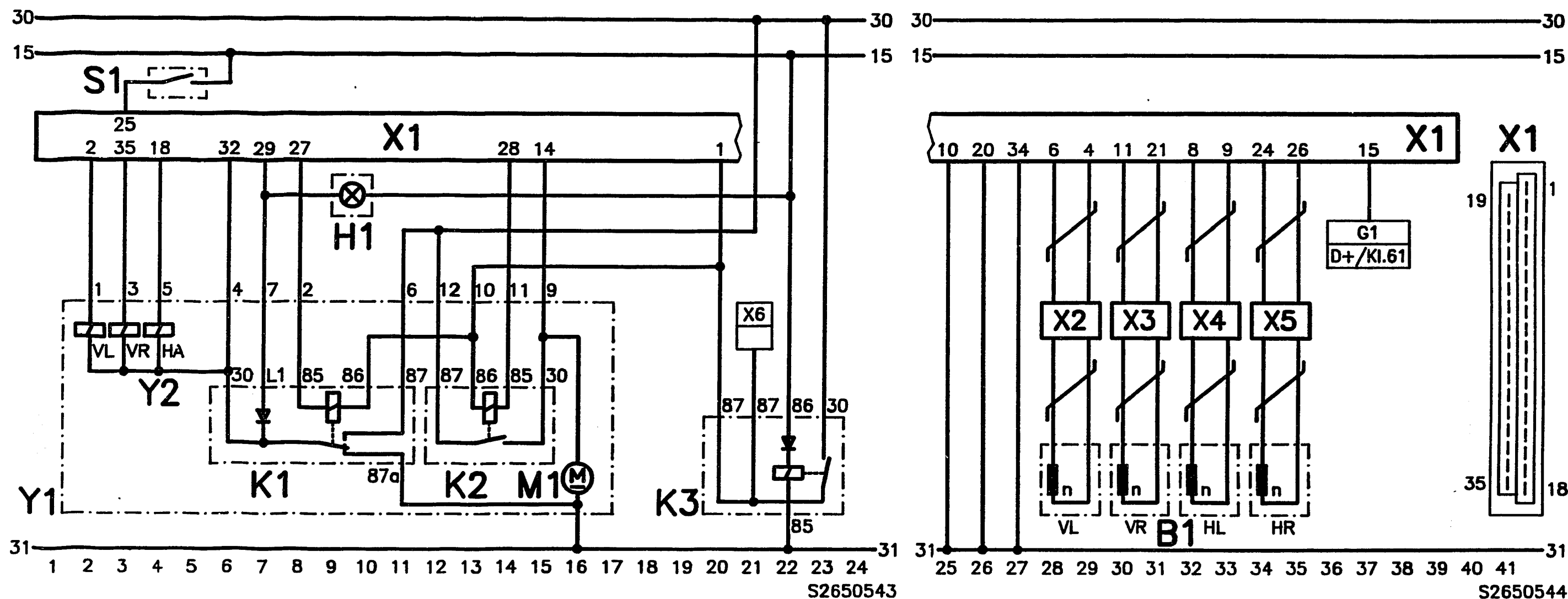
ELECTRICAL TERMINAL DIAGRAM  
for BMW 3181, 3201, 3251 and 325e up to 8.88 and 324td

B1 = Wheel-speed sensor  
G1 = to alternator  
H1 = ABS warning lamp  
K1 = Valve relay  
K2 = Motor relay  
K3 = Over-voltage protection relay

M1 = Return-pump motor  
S1 = Stop-lamp switch  
X1 = Controller plug (35-pole)  
X2...X5 = Wheel-speed-sensor plugs  
Y1 = Hydraulic modulator  
Y2 = Solenoid valves

HL = Rear left  
HR = Rear right  
VL = Front left  
VR = Front right



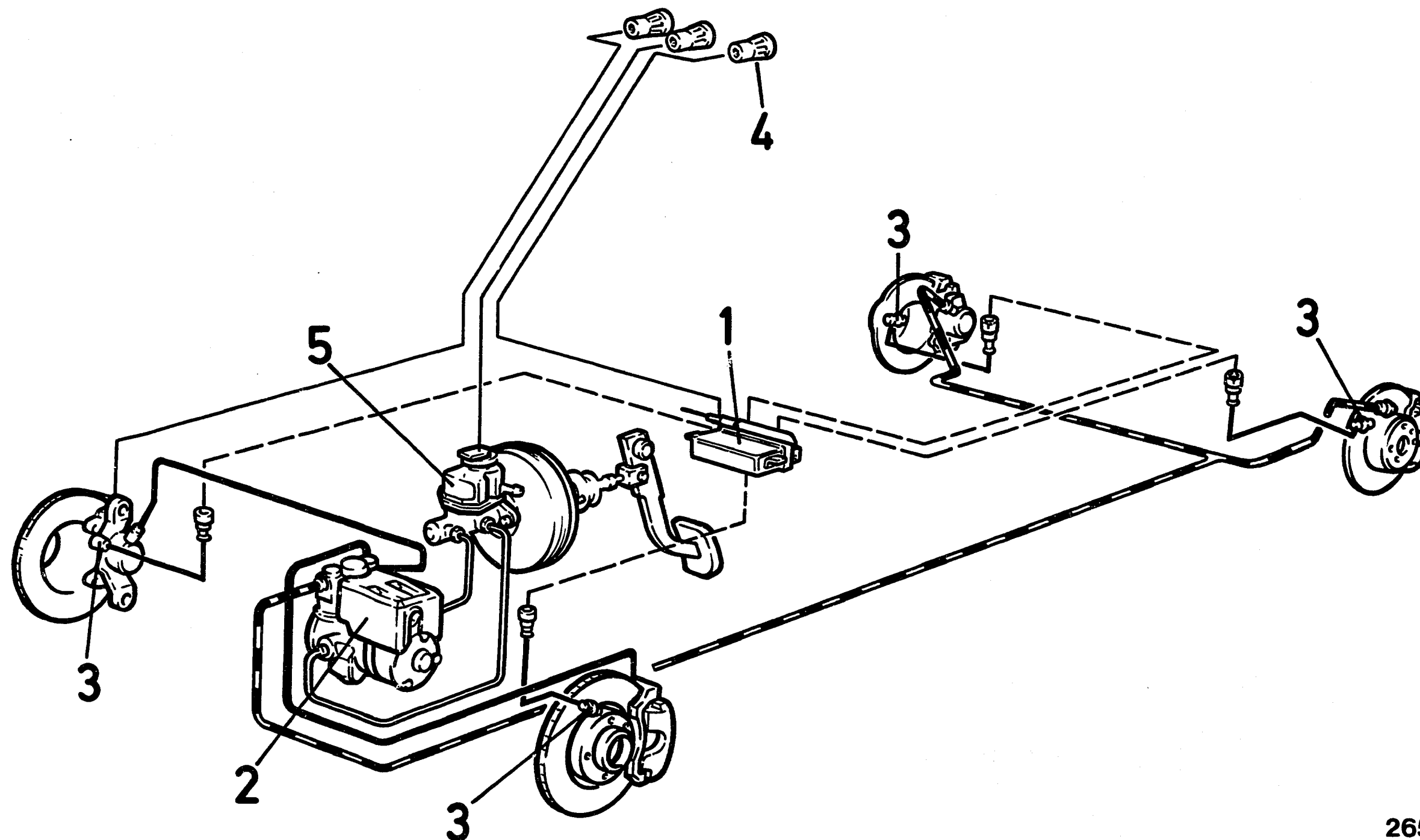


ELECTRICAL TERMINAL DIAGRAM  
for BMW 318i, 320i, 325i and 325e as of 9.88

B1 = Wheel-speed sensor  
G1 = to alternator  
H1 = ABS warning lamp  
K1 = Valve relay  
K2 = Motor relay  
K3 = Motronic relay

M1 = Return-pump motor  
S1 = Stop-lamp switch  
X1 = Controller plug (35-pole)  
X2...X5 = Wheel-speed-sensor plugs  
X6 = Voltage supply for Motronic  
Y1 = Hydraulic modulator

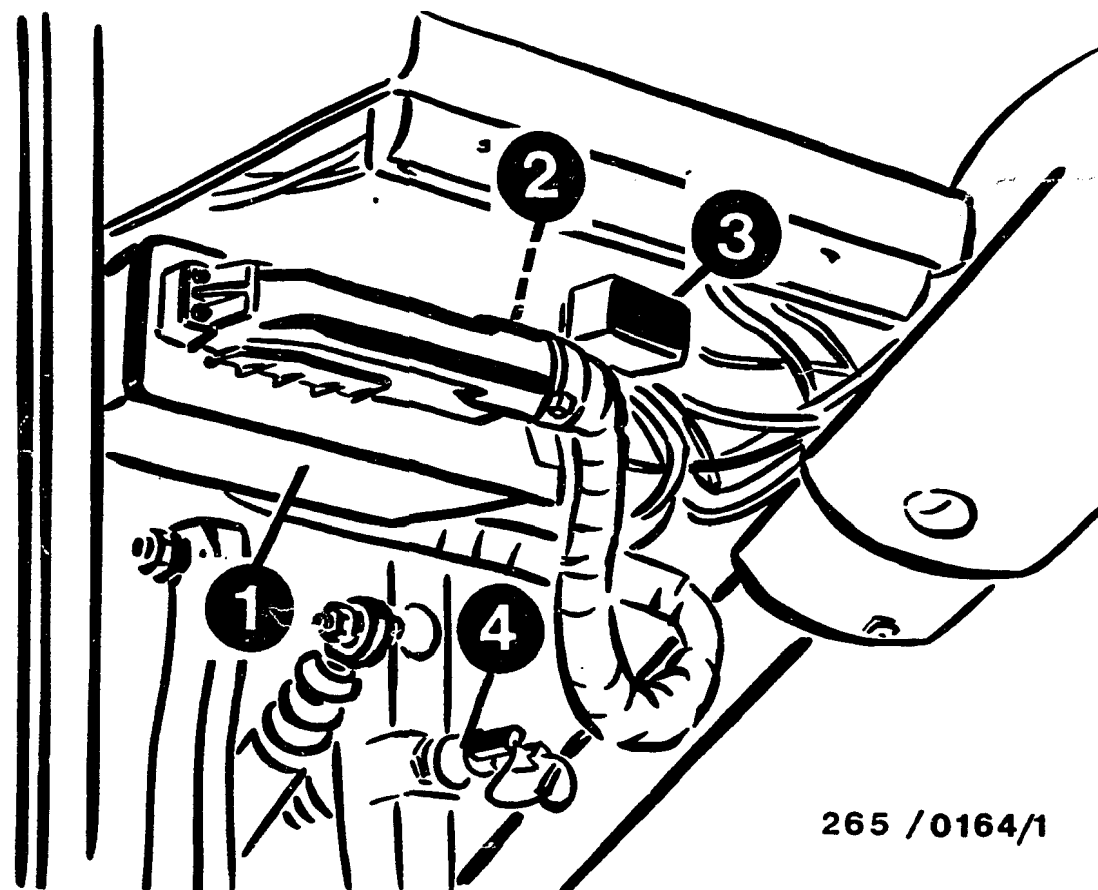
Y2 = Solenoid valves  
HL = Rear left  
HR = Rear right  
VL = Front left  
VR = Front right



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# INSTALLATION POSITION OF COMPONENTS

- 1 = ABS controller
- 2 = Hydraulic modulator
- 3 = Wheel-speed sensor
- 4 = ABS warning lamp
- 5 = Brake fluid reservoir



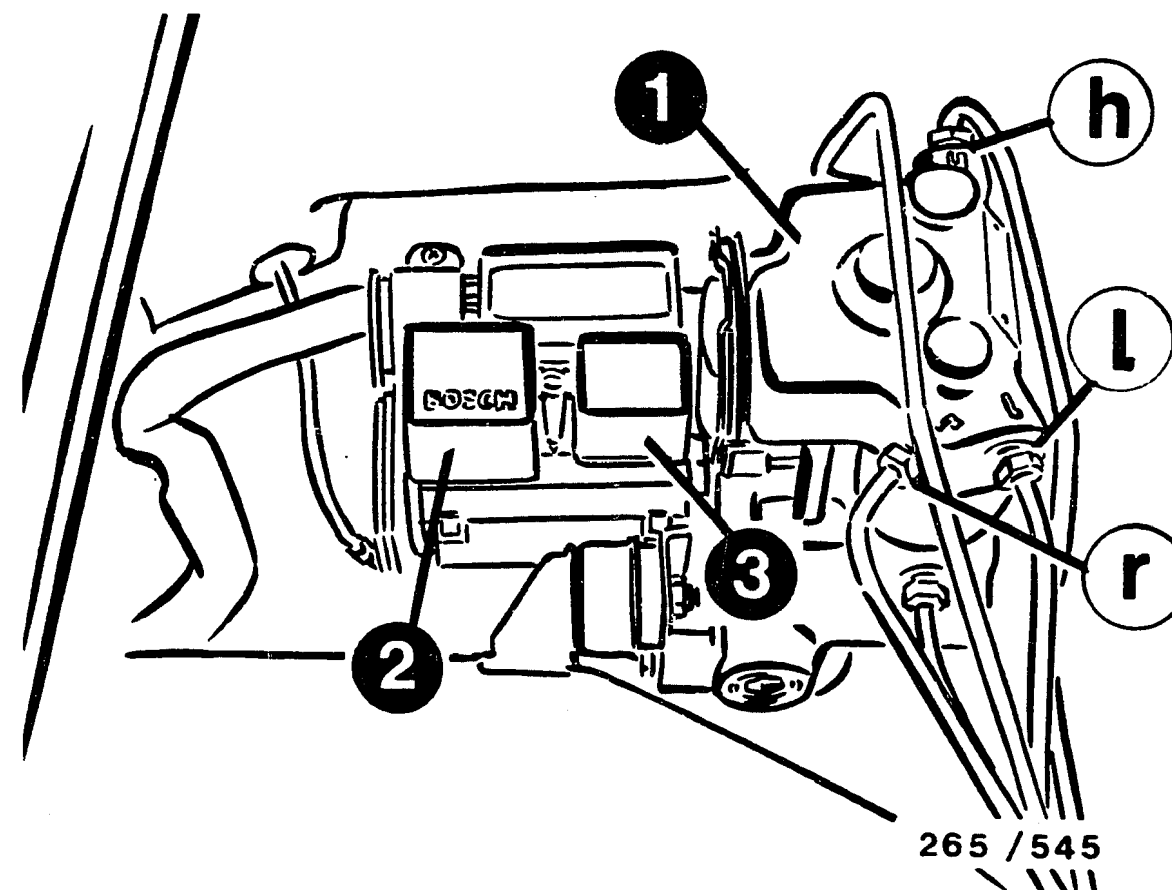
265 / 0164/1

- 1 = ABS controller
- 2 = Ground terminal
- 3 = Over-voltage protection relay
- 4 = Stop-lamp switch

#### INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

- \* Controller:  
To the left of the steering column. Remove bottom left trim.
- \* Over-voltage protection relay:  
On right above controller, clipped into sheet-metal bracket.  
As of 9.88 the voltage supply for the ABS is tapped from the Motronic relay term. 87 (except diesel vehicles)  
318i: Motronic relay in engine compartment at bulkhead, relay color white.  
320i, 325i, 325e: Motronic relay (white) in engine compartment on left in front of spring-strut dome.

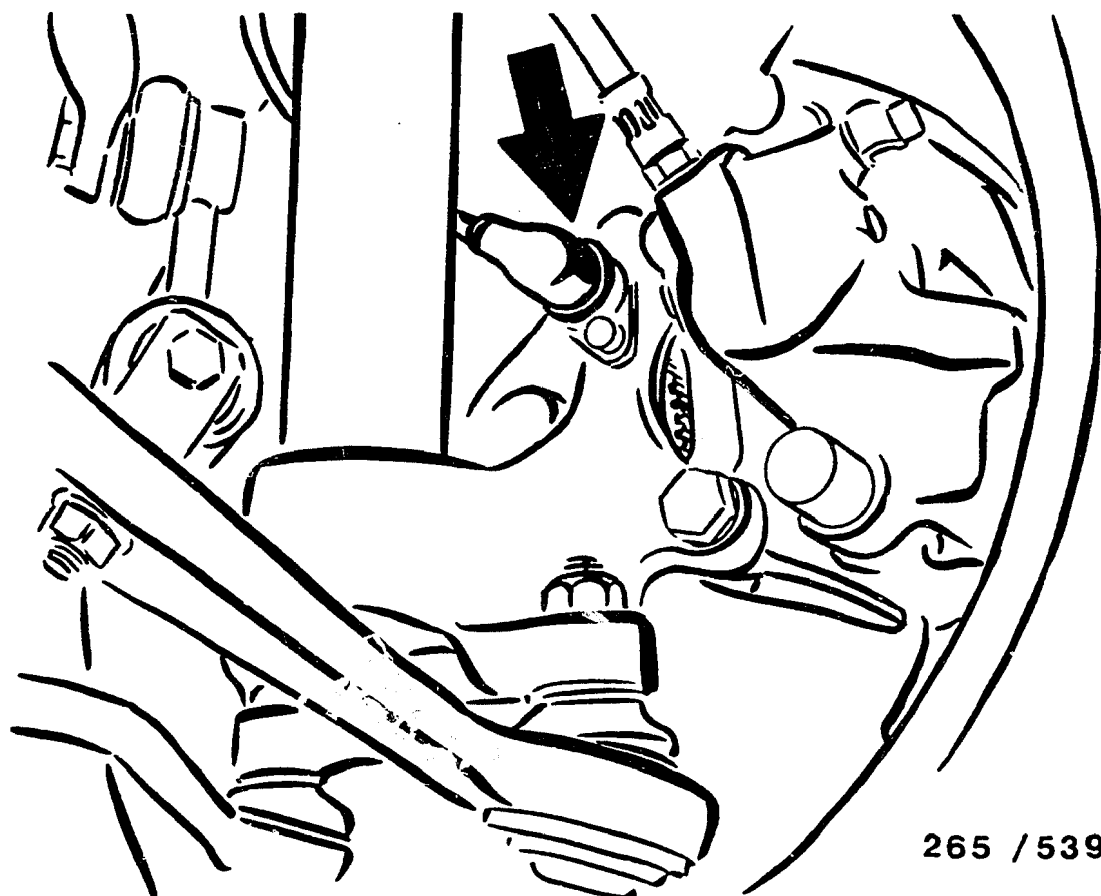


265 / 545

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Hydraulic modulator:  
In engine compartment behind left-hand headlight.  
  
The hydraulic modulator is not to be repaired, but rather only replaced as a complete assembly.  
Exception: Change of relay.  
  
Pay attention to correct assignment of brake-line connections.
- \* Stop-lamp switch:  
Beneath brake-pedal lever.



Arrow = Wheel-speed sensor, front right

#### INSTALLATION POSITION OF COMPONENTS (continued)

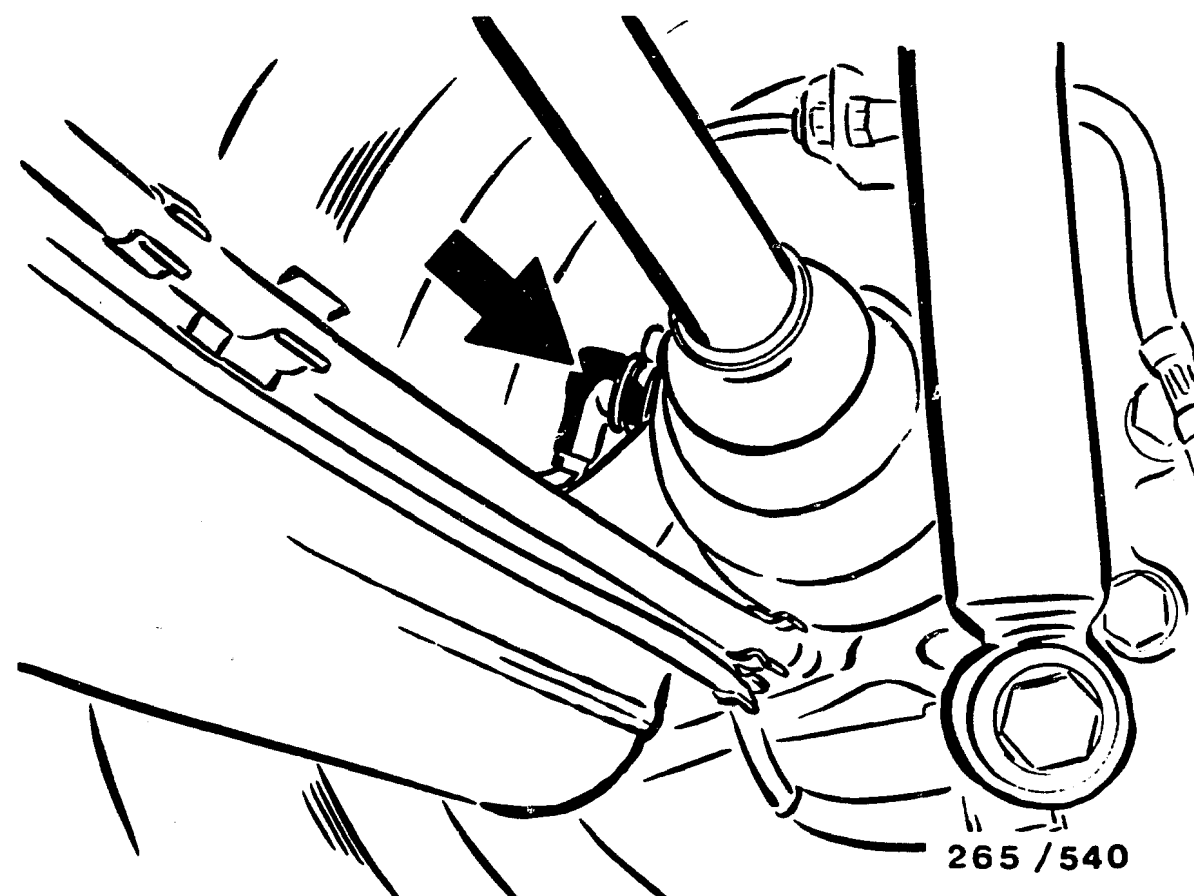
- \* Front-axle wheel-speed sensor:  
One each on left and right in steering knuckles.

##### Note:

Take care not to mix up wheel-speed sensors between left and right, as otherwise the air gap becomes too large and the signal too small.

##### Wheel-speed-sensor plug connections:

In engine compartment on left and right in front of spring-strut domes.



Arrow = Wheel-speed sensor, rear right

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Rear-axle wheel-speed sensor:  
One each on left and right at wheels ahead of drive shaft.

##### Wheel-speed-sensor plug connections:

On left and right beneath rear seat bench.

- \* ABS warning lamp:  
In instrument panel.
- \* ABS ground terminal:  
On left next to steering column. Remove lower left trim.



## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 5 and term. 4.  
front right to term. 23 and term. 21.  
rear left to term. 7 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!  
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.  
Repeat the complete test program after any repairs are carried out.  
The Antiskid System is a vehicle safety system.  
Work on the system demands detailed knowledge of the system.  
The conventional brake system must be O.K.

### General information for trouble-shooting:

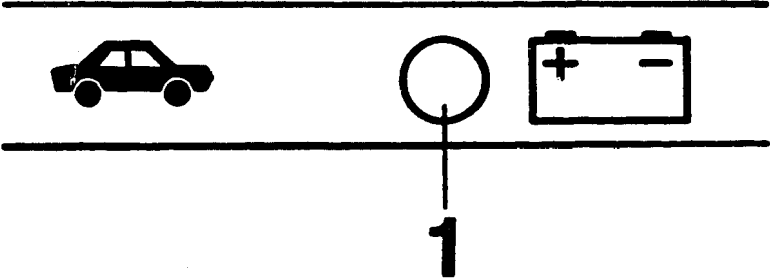
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

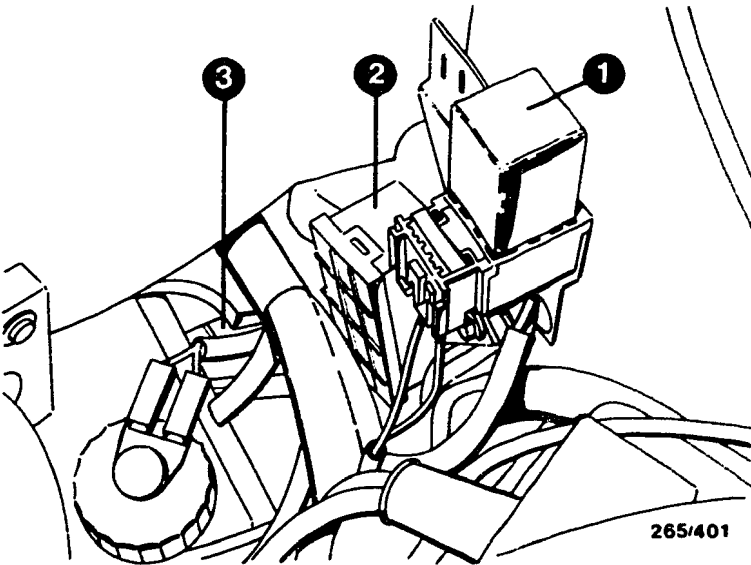
Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply  (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none"><li>*Battery insufficiently charged</li><li>*High voltage drops</li><li>*Overvoltage-protection relay defective</li><li>*Check lead to ignition and starting switch, term. 15</li></ul>



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- 1 = Overvoltage-protection relay
- 2 = Socket with positive and ground terminals
- 3 = Wheel-speed-sensor plug-in connection

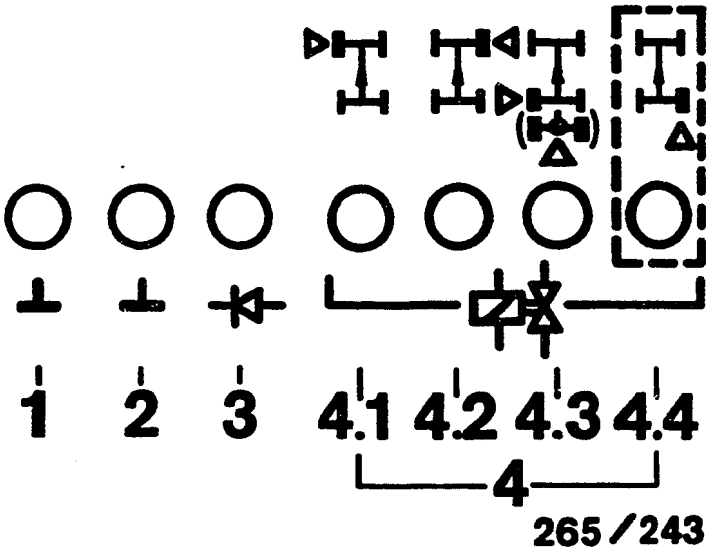


265/401

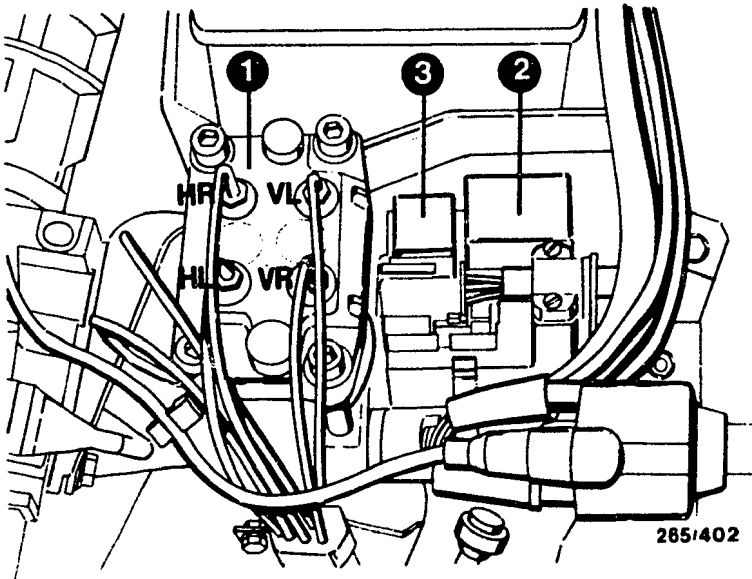
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 Ω</li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay

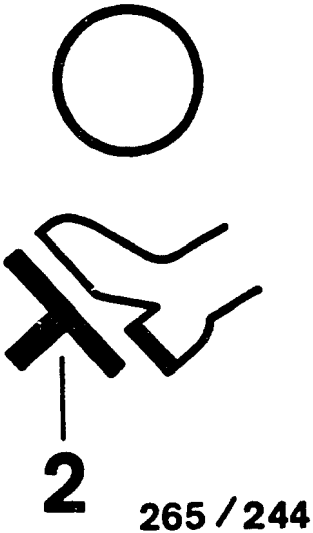




RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

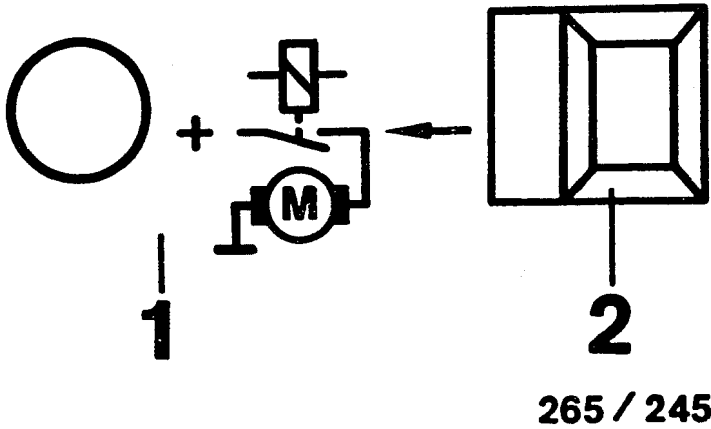


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RAPID DIAGNOSIS CHART (CONTINUED)

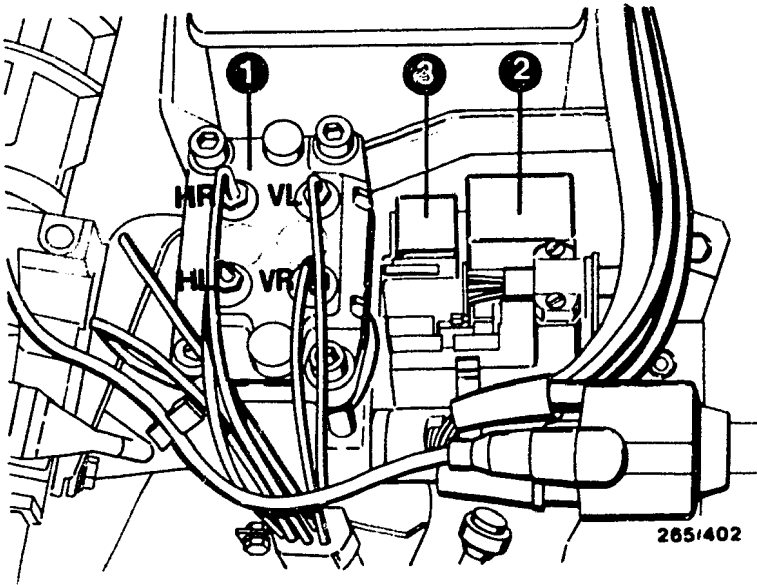
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 2.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



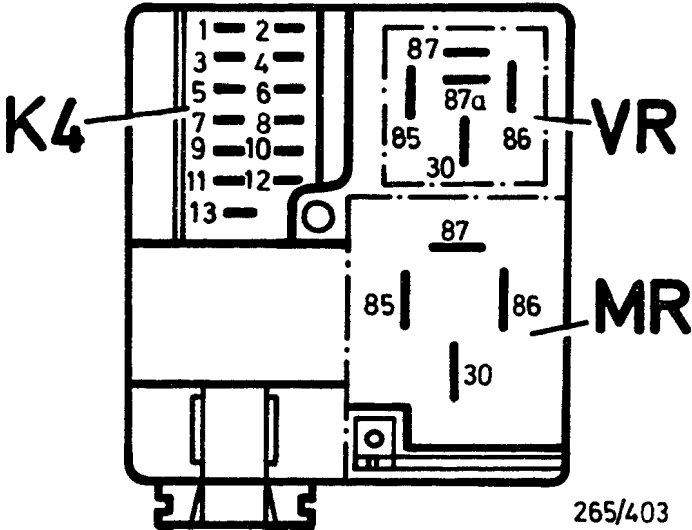
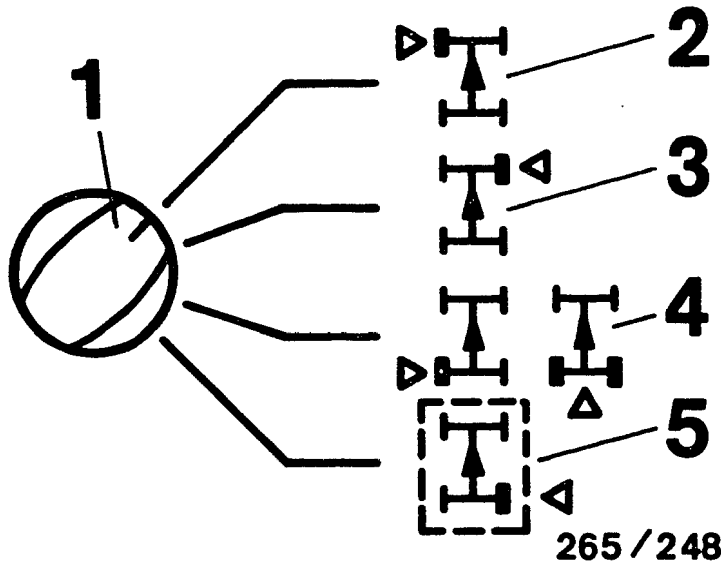
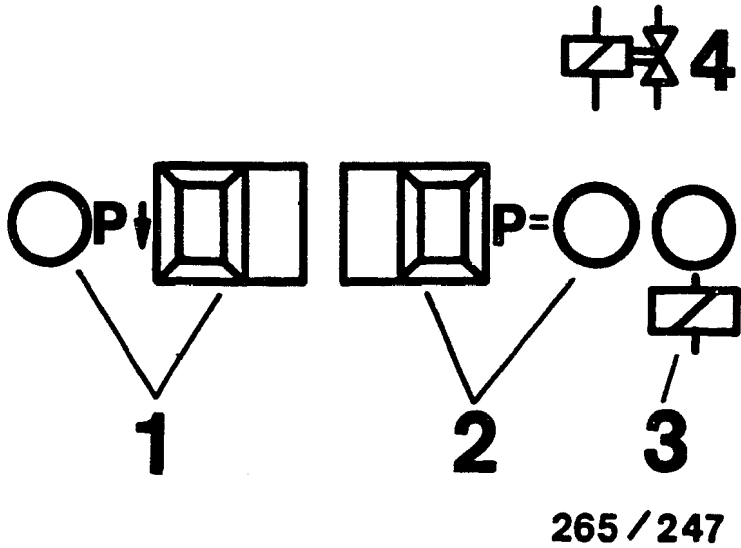
Program-selector-switch position 4 not applicable.

1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (4-channel hydraulic modulator)

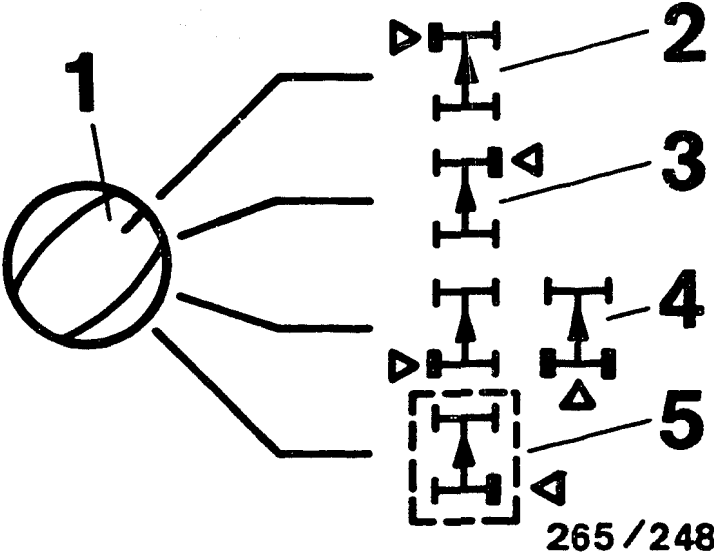
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydraulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+  * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration) lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.18 Wheel, rear right: term.19 Rear axle: term. -  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

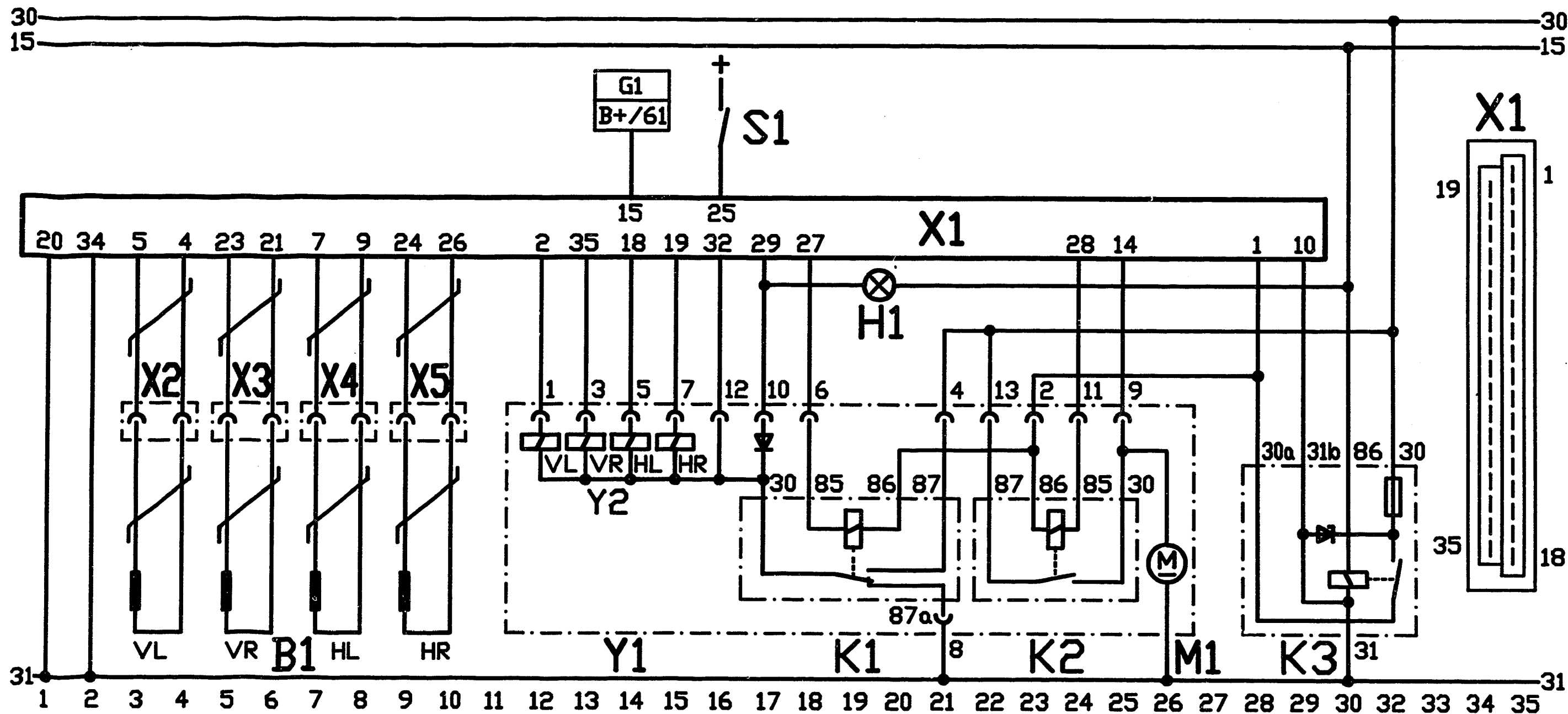
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and t.5</p> <p>Wheel, front right: term.23 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,0 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 90 teeth Rear axle: 90 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



TEST SPECIFICATIONS

Wheel-speed sensor		
* Winding resistance at ambient temperature (-10°C...+120°C) for		
Front axle:	600...1600	Ω
Rear axle:	600...1600	Ω
Hydraulic-modulator solenoid-operated valves		
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7	Ω
Air gap:	0,8 ±0,5	mm
Tightening torque for		
* Fastening screws of wheel-speed sensors:	> 8	Nm
* Brake-line connections on hydraulic modulator:	12...16	Nm
Number of teeth		
* Front axle:	90	teeth
* Rear axle:	90	teeth

For production reasons:  
continued on the following  
coordinate.



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# ELECTRICAL TERMINAL DIAGRAM

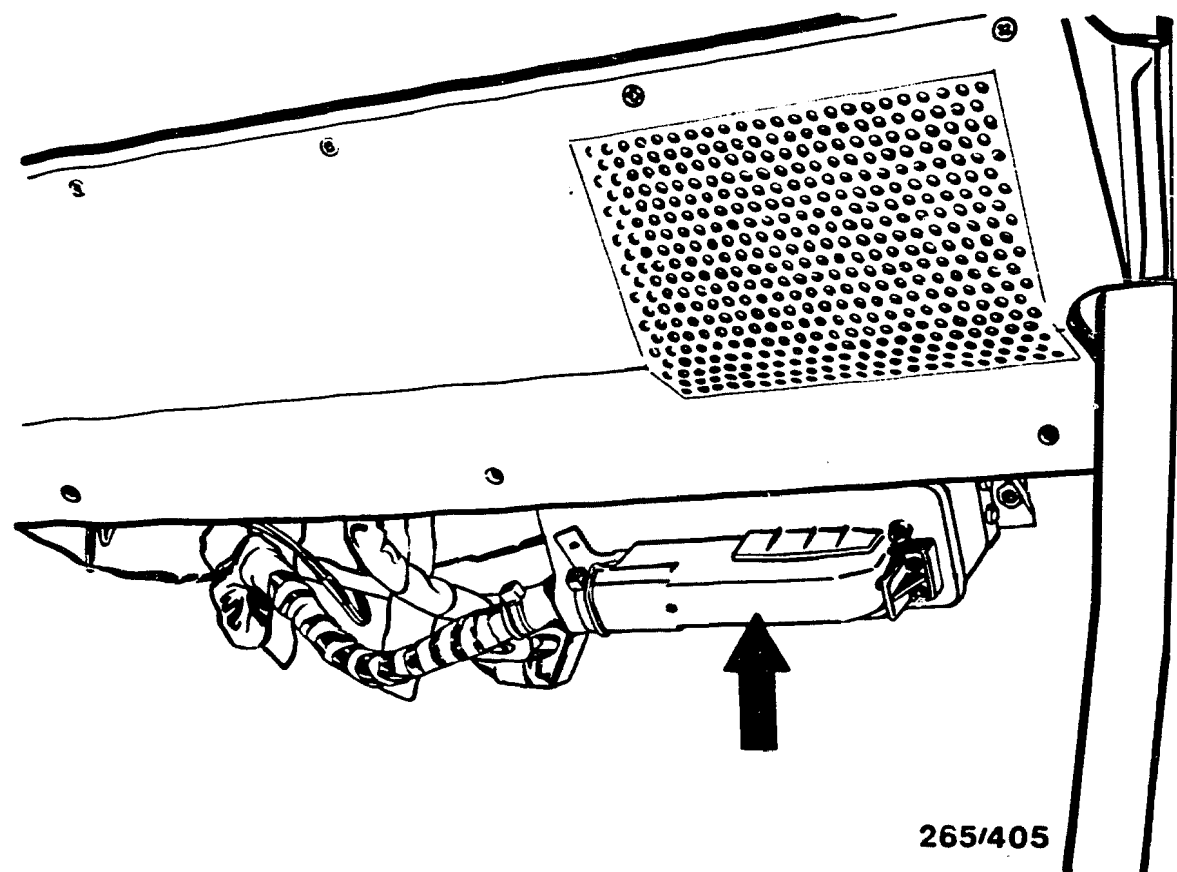
B1 = Wheel-speed sensor  
 G1 = To alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Overvoltage-protection relay

M1 = Return-supply-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pin)  
 X2...X5 = Wheel-speed-sensor plug  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves

HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right

J19 —————>

J20 —————<==

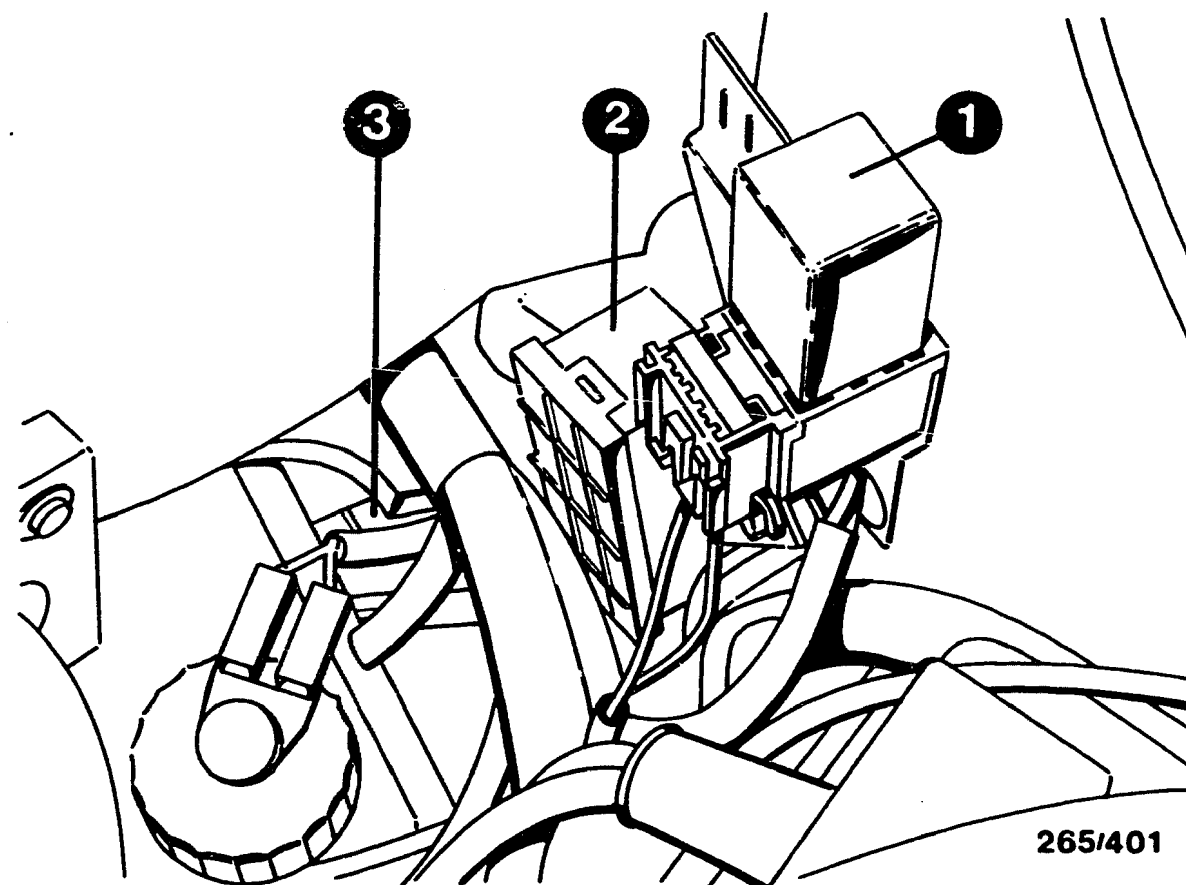


Arrow = ABS controller

#### INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

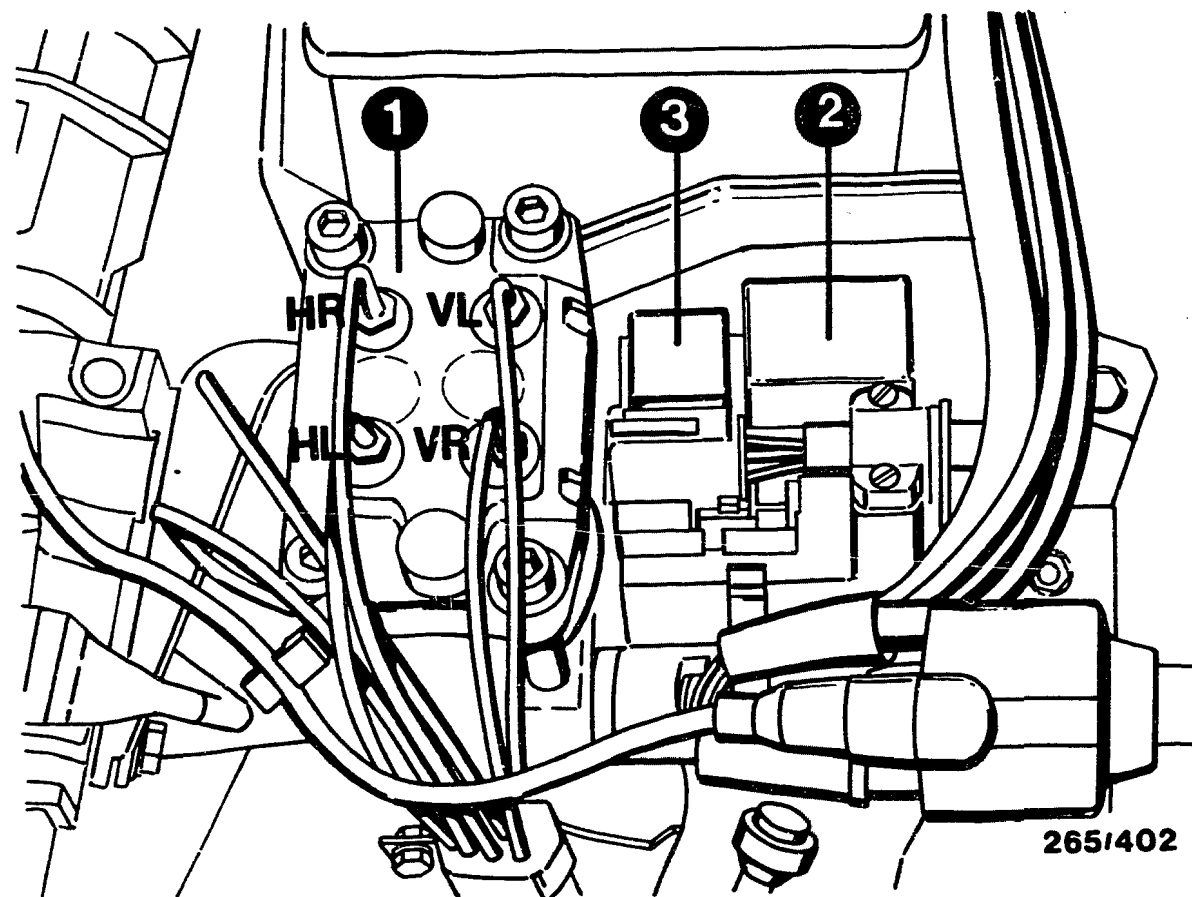
- \* Controller:  
in the passenger-side footwell beneath the glove compartment. Unscrew the lower panel.
- \* ABS warning lamp: in the instrument panel.  
Symbol: skidding car.
- \* Stop-lamp switch:  
on the brake pedal.



- 1 = Overvoltage-protection relay
- 2 = Socket with positive and ground terminals
- 3 = Wheel-speed-sensor plug-in connection

#### INSTALLATION POSITION OF COMPONENTS (Continued)

- \* Overvoltage-protection relay:  
in the engine compartment on the left-hand McPherson strut dome.
- \* Ground terminal:  
in the engine compartment on the left-hand McPherson strut dome beneath the overvoltage-protection relay.  
Ground terminal is located in a housing for positive and ground terminals.



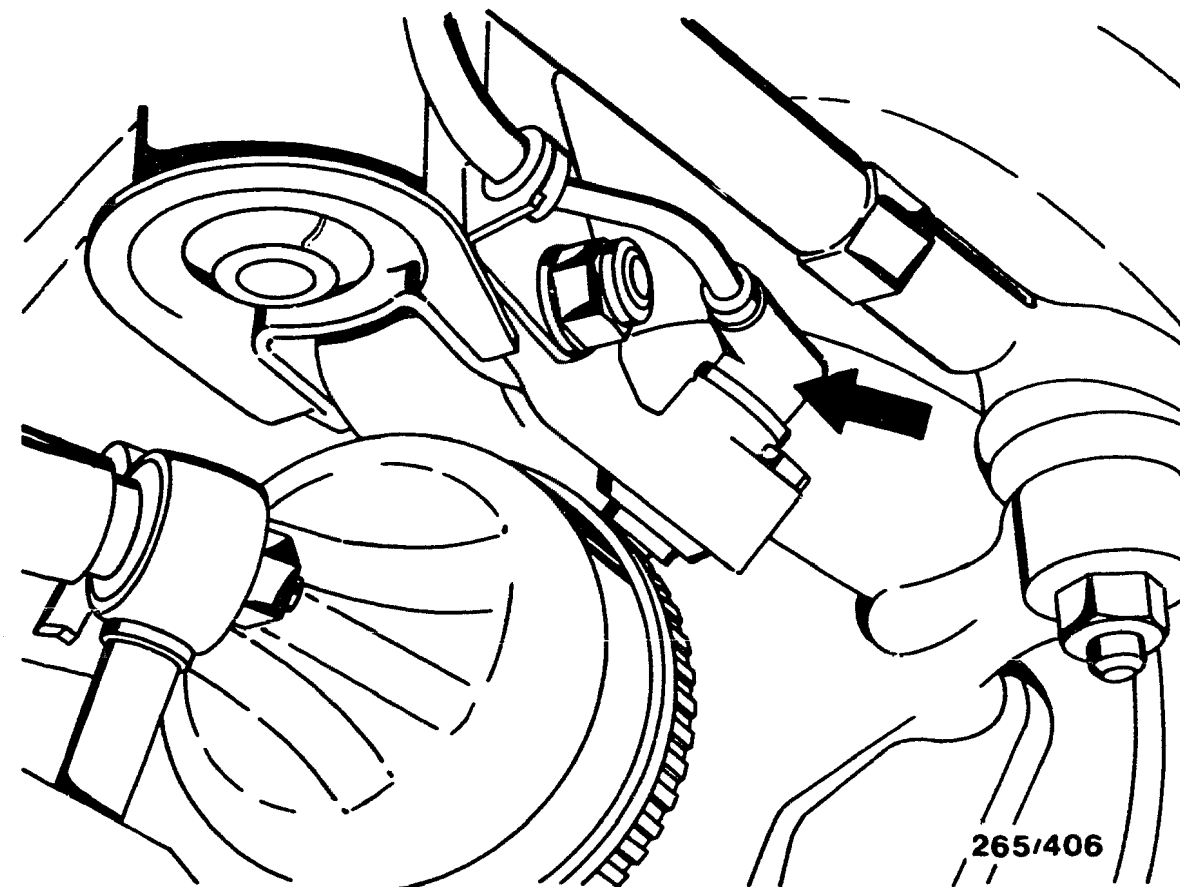
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

#### INSTALLATION POSITION OF COMPONENTS (Continued)

- \* Hydraulic modulator:  
in the engine compartment at the front on the left-hand side in front of the battery.

The hydraulic modulator must not be repaired, but be exchanged only as a complete unit.  
Exception: relays may be exchanged.

Make sure that the brake-line connections are not mixed up.



Arrow = Wheel-speed sensor, front right

#### INSTALLATION POSITION OF COMPONENTS (Continued)

- \* Wheel-speed sensors, front axle:  
one on each side in the steering knuckles.  
If required, insert shims to give the correct air gap.

Wheel-speed-sensor plug-in connections:  
on the McPherson strut domes in the engine compartment.

- \* Wheel-speed sensors, rear axle:  
one on each side on the wheels.

Wheel-speed-sensor plug-in connections:  
on the left and right in the luggage compartment in the wheel houses under the side panelling.



Trouble-shooting instructions : FIA-5004

BOSCH system : ABS

Make of vehicle : FIAT

Basic microcard : PKW-040

TABLE OF CONTENTS

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Test requirements .....	03
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SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

Fiat Tipo turbo D  
1.1988 ->

- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gear with 44 teeth.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 5 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 7 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!  
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.  
Repeat the complete test program after any repairs are carried out.  
The Antiskid System is a vehicle safety system.  
Work on the system demands detailed knowledge of the system.  
The conventional brake system must be O.K.

### General information for trouble-shooting:

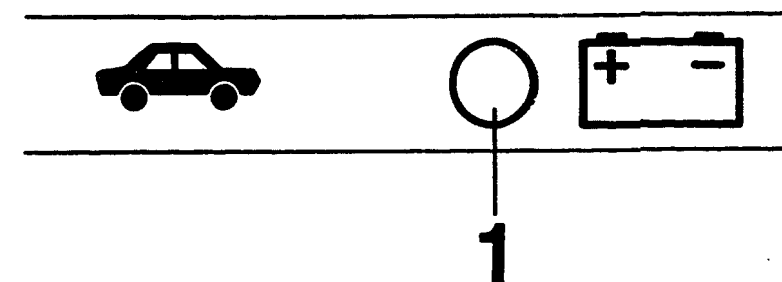
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

## RAPID DIAGNOSIS CHART

**Do not drive with tester connected! Have all test prerequisites been satisfied?**

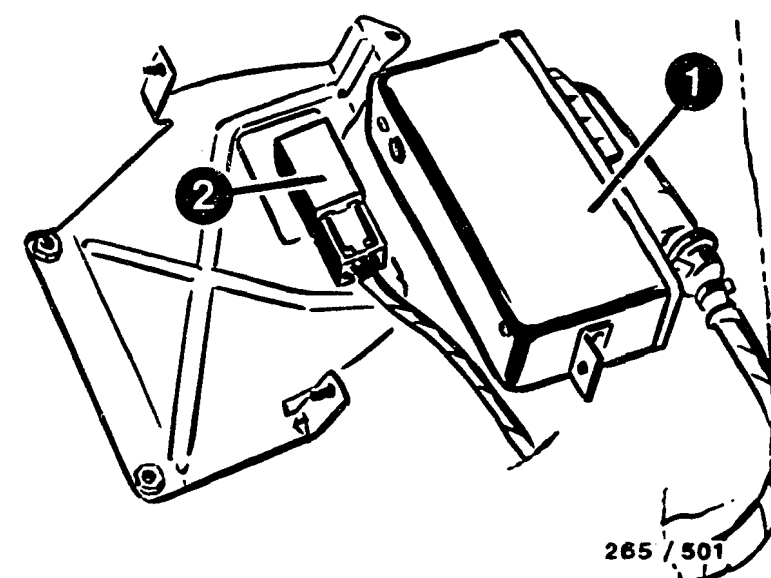
### Program-selector-switch settings 1 - 6

Testing of (Measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (Term.1 and term.20)	Ignition on	LED 1 (top picture) lights up continuously	<ul style="list-style-type: none"> <li>* Fuse defective.</li> <li>* Inadequate battery charge.</li> <li>* Excessive voltage dips.</li> <li>* Test lead to driving switch, term. 15.</li> <li>* Over-voltage protection relay defective.</li> </ul>



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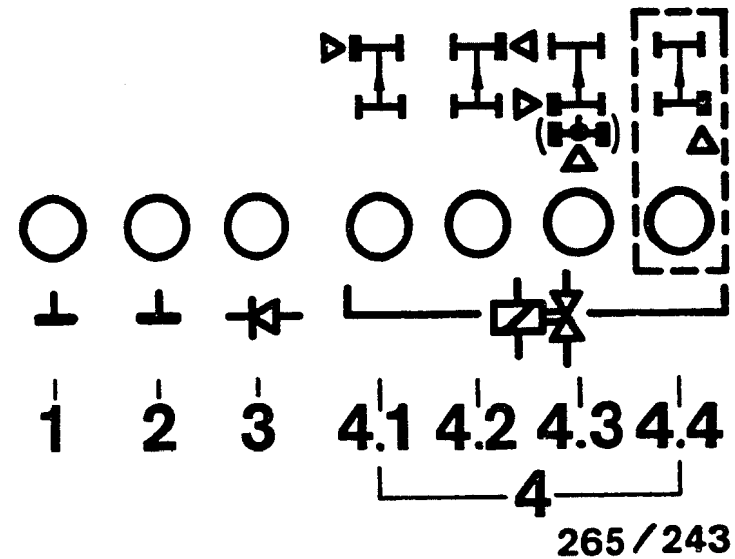
1 = ABS controller  
2 = Over-voltage protection relay



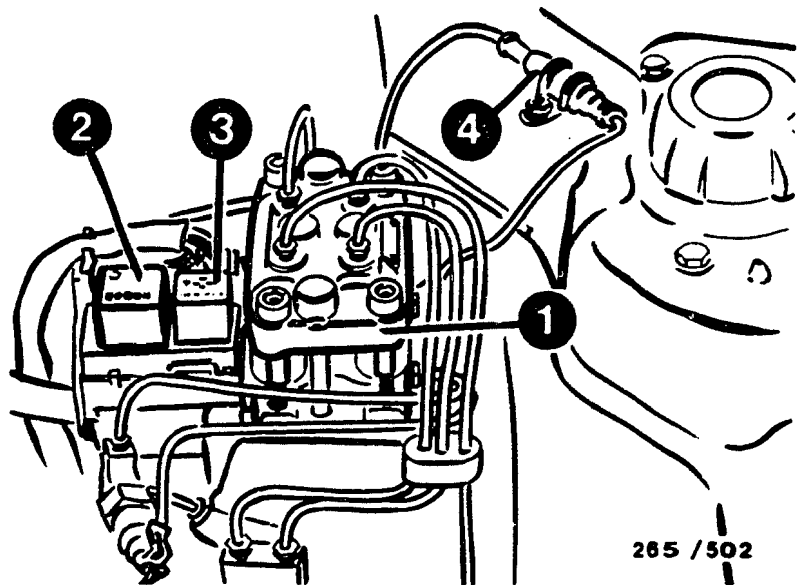
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 4.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 Ω</li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



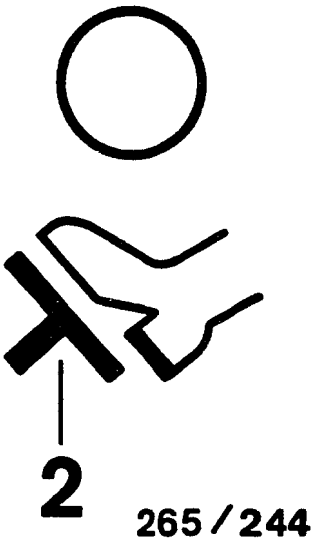
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Wheel-speed-sensor plug connection



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

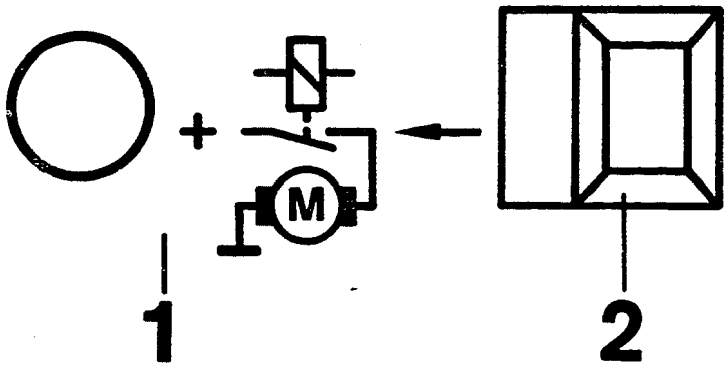


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RAPID DIAGNOSIS CHART (CONTINUED)

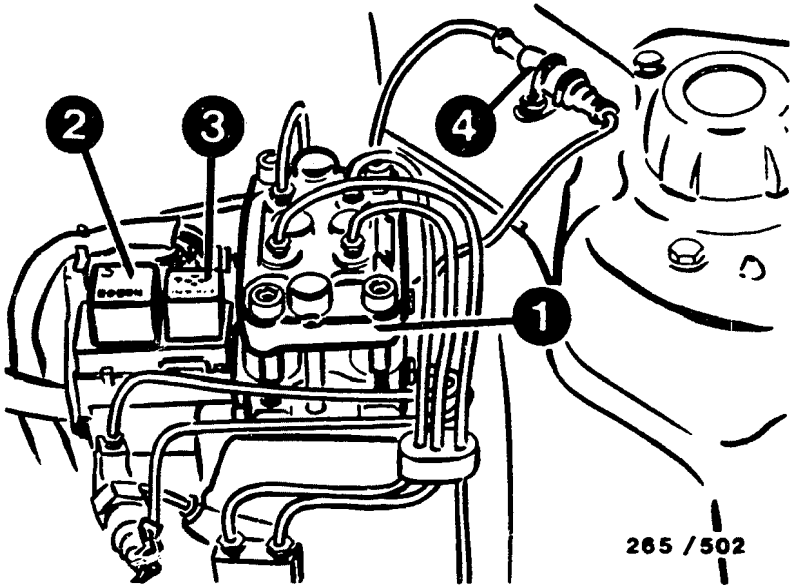
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs.  After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Test ground connection and positive terminal of pump motor</li><li>* Test following leads:  From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 12. Positive leads to hydraulic modulator term. 8 and term. 10.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



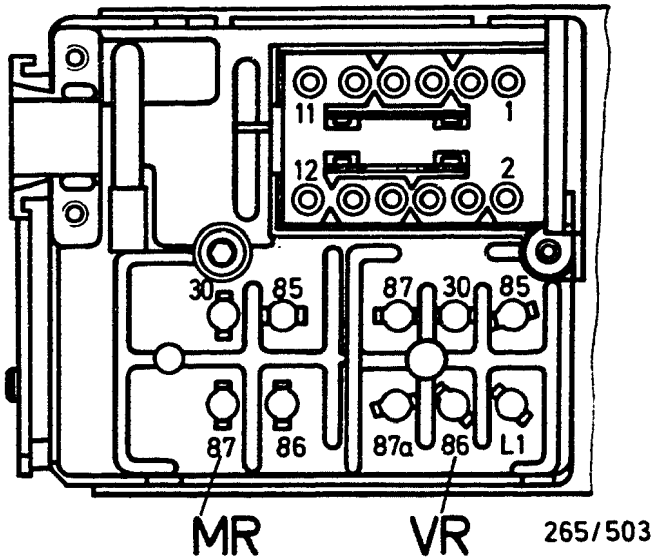
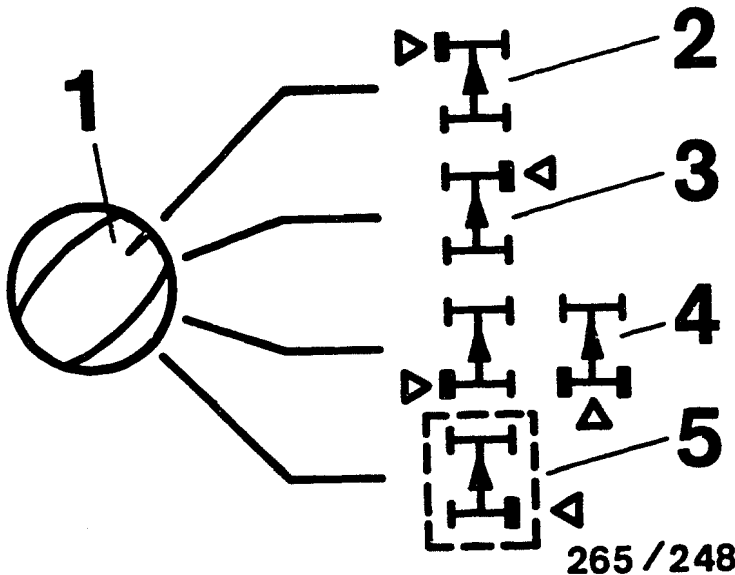
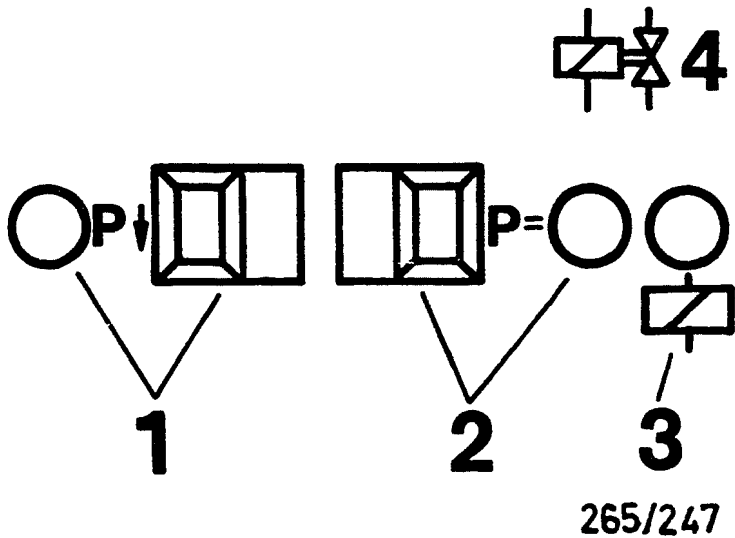
Program-selector-switch position 4 does not apply.

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay
- 4 = Wheel-speed-sensor  
plug connection



**RAPID DIAGNOSIS CHART (CONTINUED)**  
**Program-selector-switch position 5 (4-channel hydraulic modulator)**

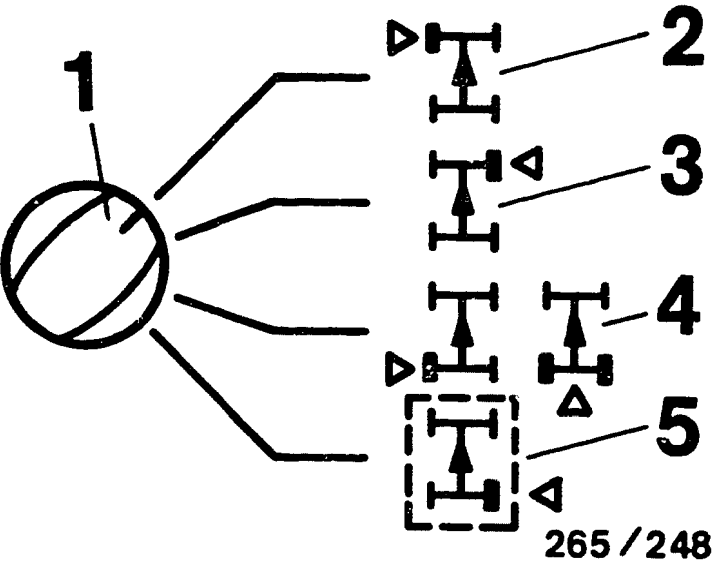
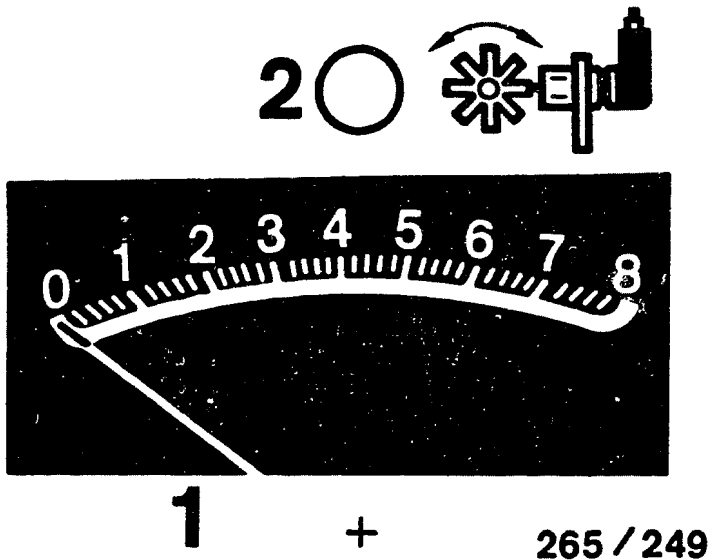
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydraulic modulator for operation and and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+  * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.18 Wheel, rear right: term.19 Rear axle: term. -  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term4 and t.5</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger <u>1,6</u> <u>divisions</u></p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 44 teeth Rear axle: 44 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>





# TEST SPECIFICATIONS

## Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:
- rear wheels:

600...1600 Ω  
600...1600 Ω

## Hydraulic-modulator solenoid valves

- \* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7 Ω

## Air gap between wheel-speed sensor and ring gear

- \* at front wheels:
- \* at rear wheels:

0,8 ± 0,5 mm  
0,8 ± 0,5 mm

## Tightening torque for

- \* fastening screws of wheel-speed sensors:

> 8 Nm

- \* Brake-line connections at hydraulic modulator:

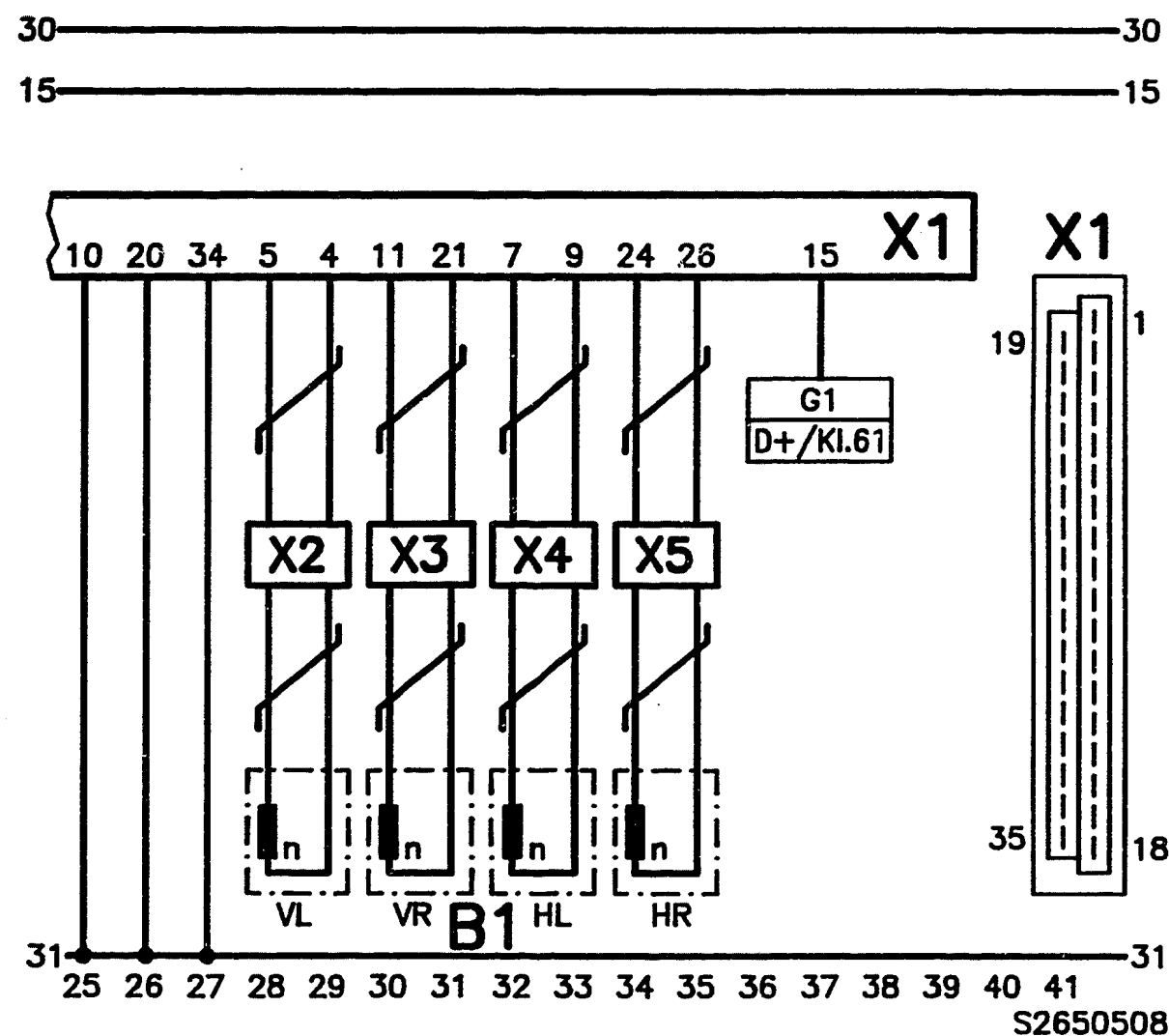
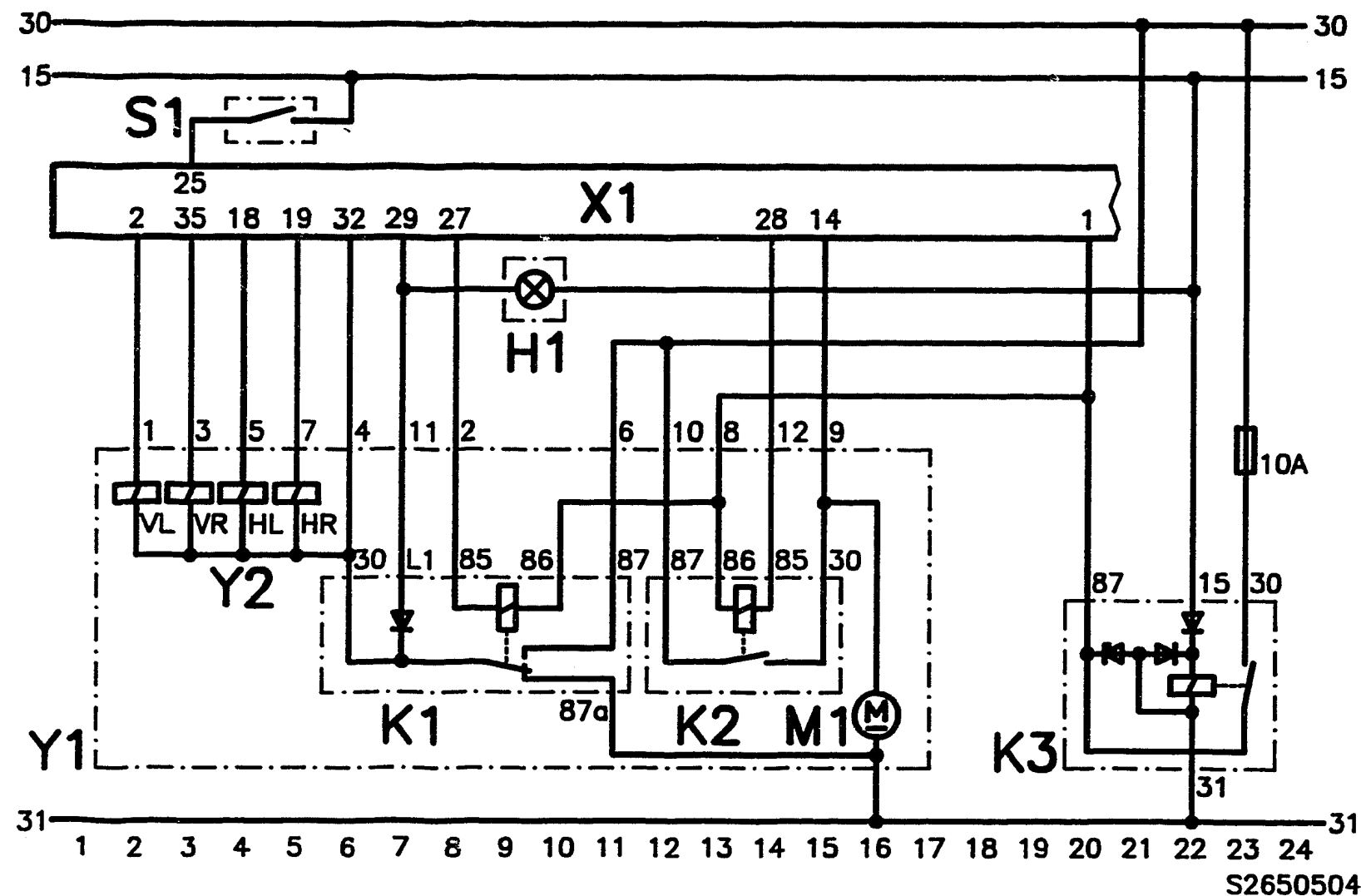
12...16 Nm

## Number of teeth on ring gears of wheel-speed sensors

- \* at front wheels:
- \* at rear wheels:

44 teeth  
44 teeth

For production reasons:  
continued on the following  
coordinate.



# ELECTRICAL TERMINAL DIAGRAM

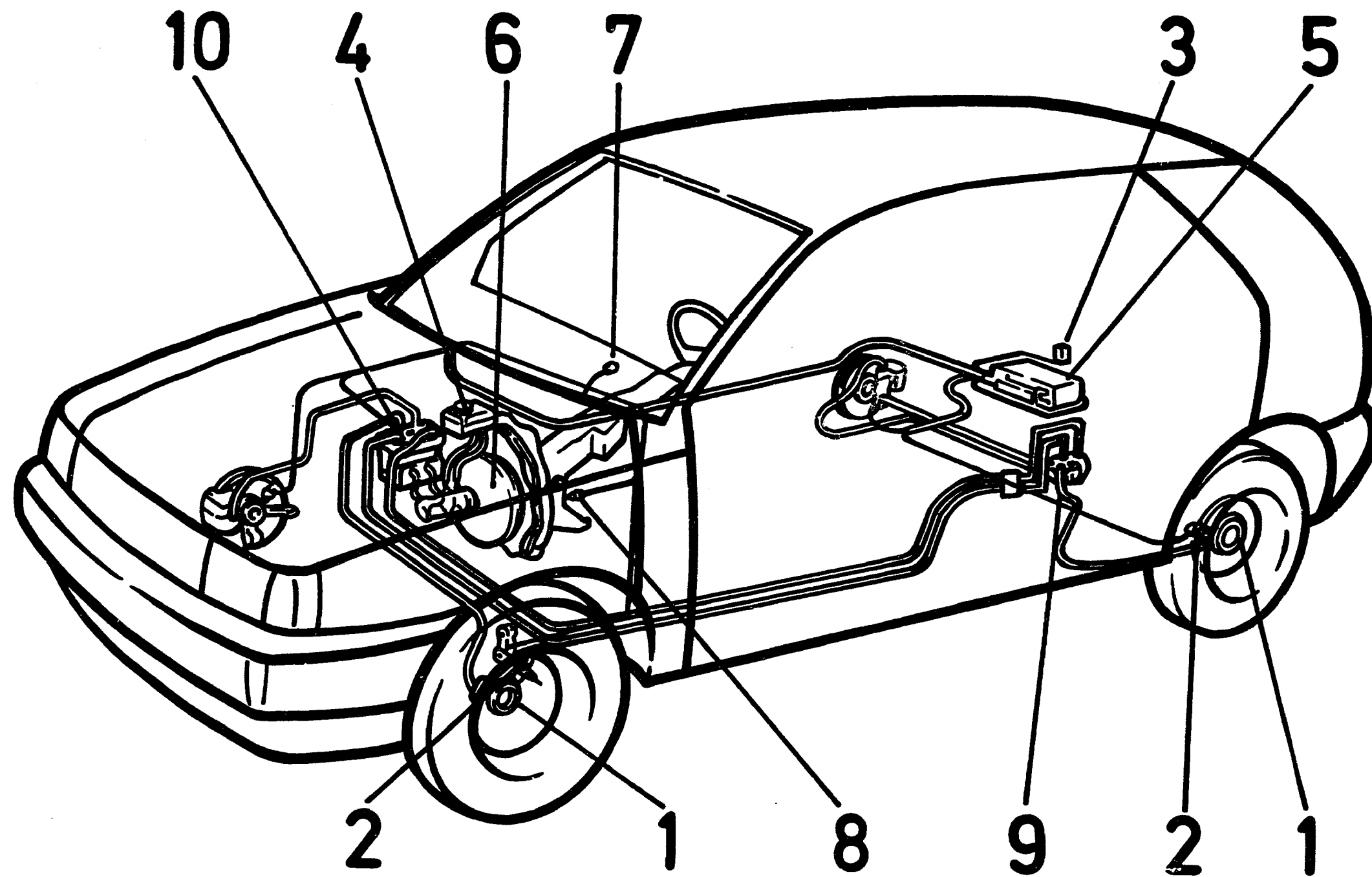
B1 = Wheel-speed sensor  
 G1 = To alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Overvoltage-protection relay

M1 = Return-supply-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pin)  
 X2...X5 = Wheel-speed-sensor plug  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid-operated valves

HL = Rear left  
 HR = Rear right  
 VL = Front left  
 VR = Front right

K19

K20

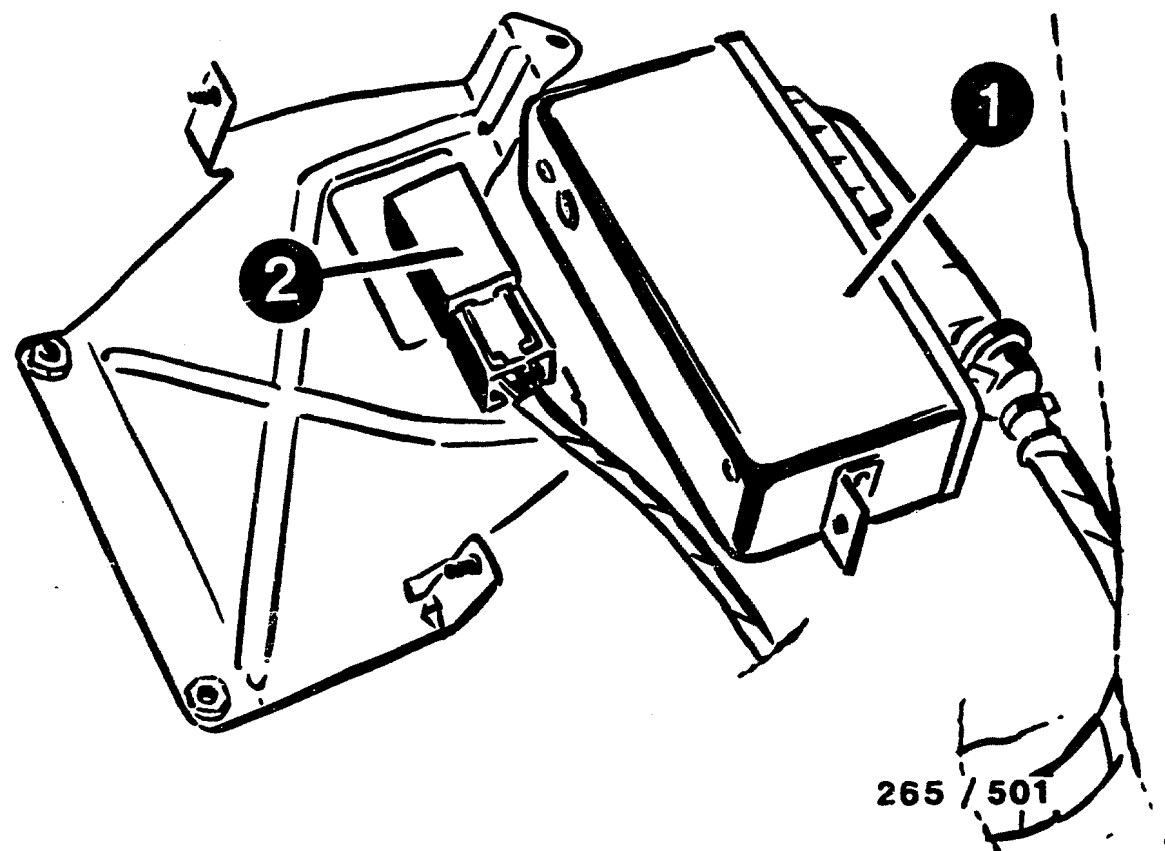


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# INSTALLATION POSITION OF COMPONENTS

- 1 = Ring gear
- 2 = Wheel-speed sensor
- 3 = Over-voltage protection relay
- 4 = Brake-fluid reservoir
- 5 = ABS controller

- 6 = Brake booster
- 7 = ABS warning lamp
- 8 = Stop-lamp switch
- 9 = Braking-force regulator
- 10 = ABS hydraulic modulator

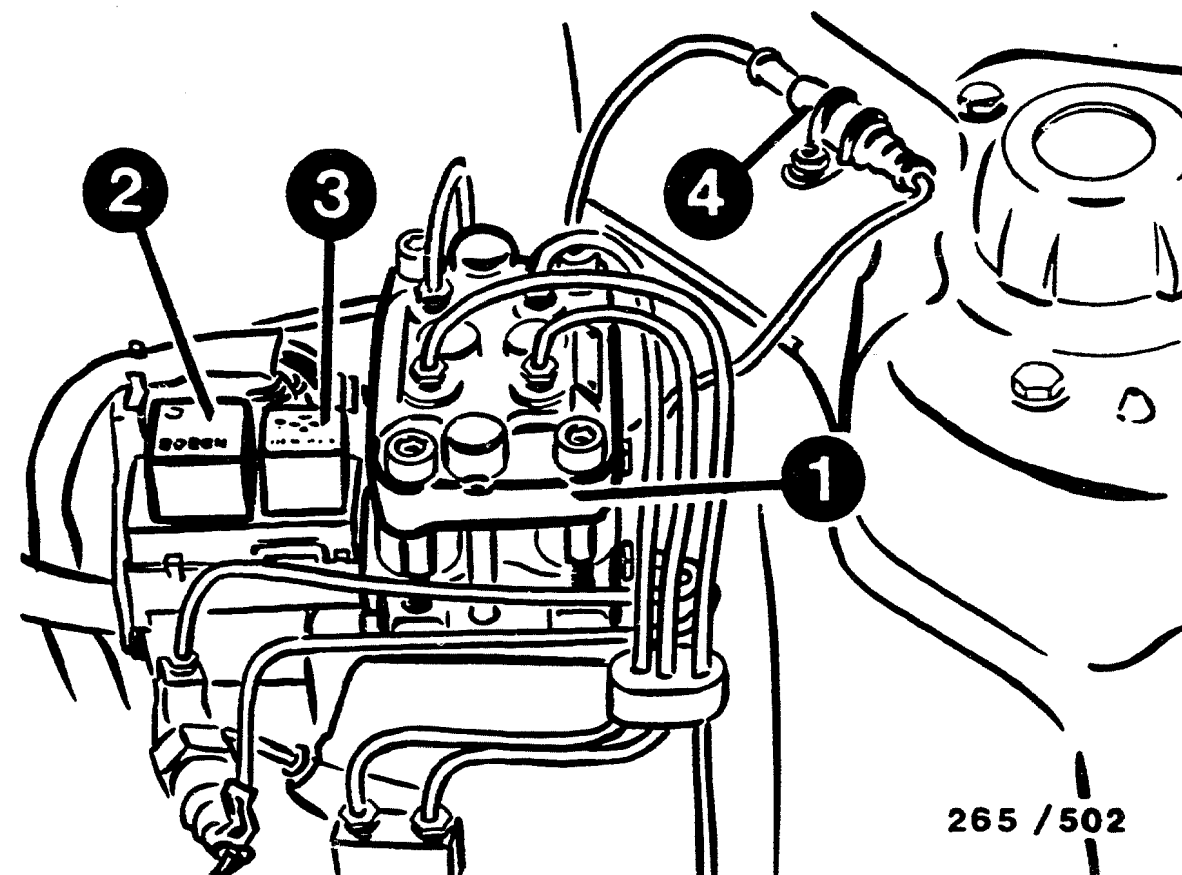


- 1 = ABS controller  
2 = Over-voltage protection relay

#### INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

- \* Controller:  
Beneath rear seat bench. Remove cover plate.
- \* Over-voltage protection relay:  
At controller beneath rear seat bench, attached to cover plate. Remove cover plate.
- \* ABS warning lamp: In instrument panel.  
Symbol: Skidding car.
- \* Stop-lamp switch:  
At brake pedal.



- 1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay  
4 = Wheel-speed-sensor plug connection

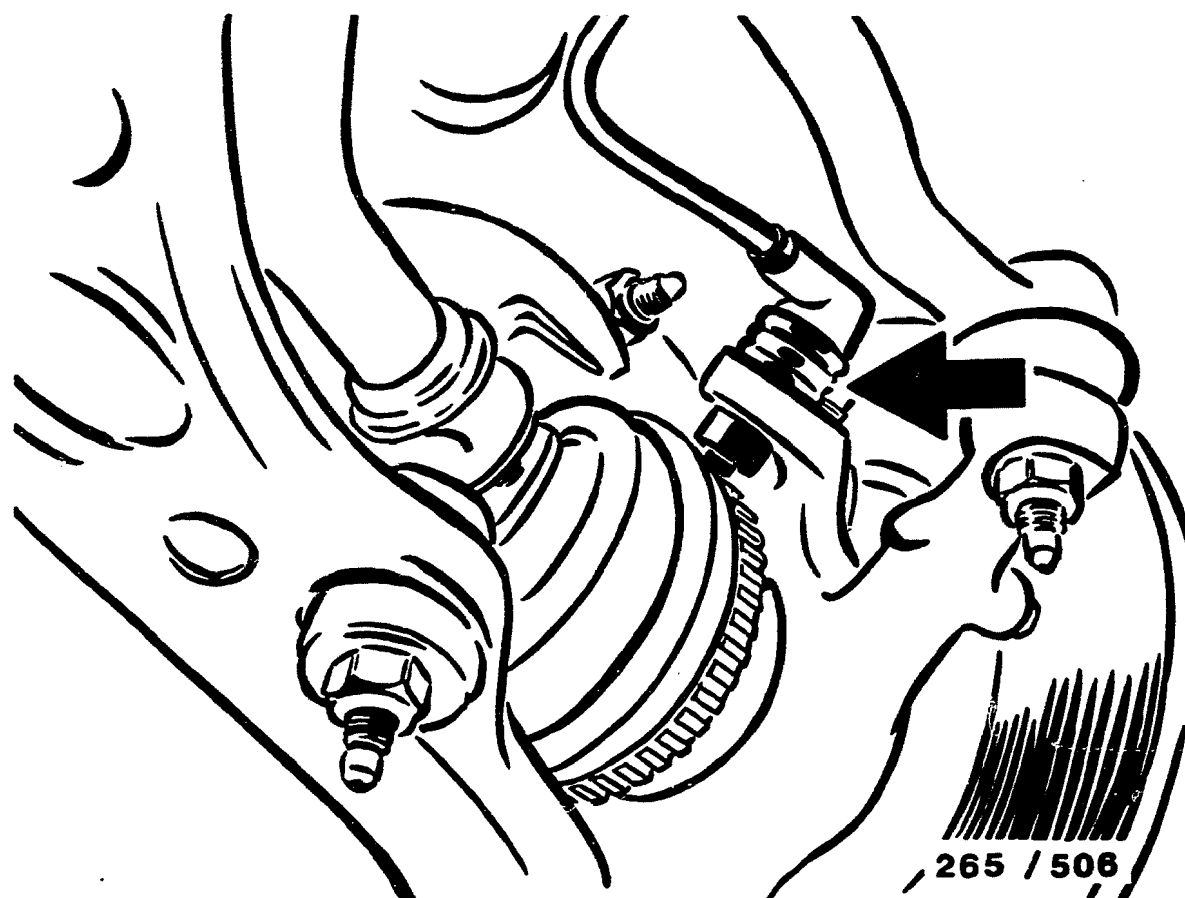
#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Hydraulic modulator:  
In engine compartment, on left, beneath brake-fluid reservoir.  
To remove, unscrew air hose and brake-fluid reservoir.

The hydraulic modulator is not to be repaired, but rather only replaced as a complete unit.  
Exception: change of relay.

Pay attention to correct assignment of brake-line connections.

- \* ABS ground terminal:  
In trunk beneath right-hand rear lamp at bodywork. Fold back carpet.

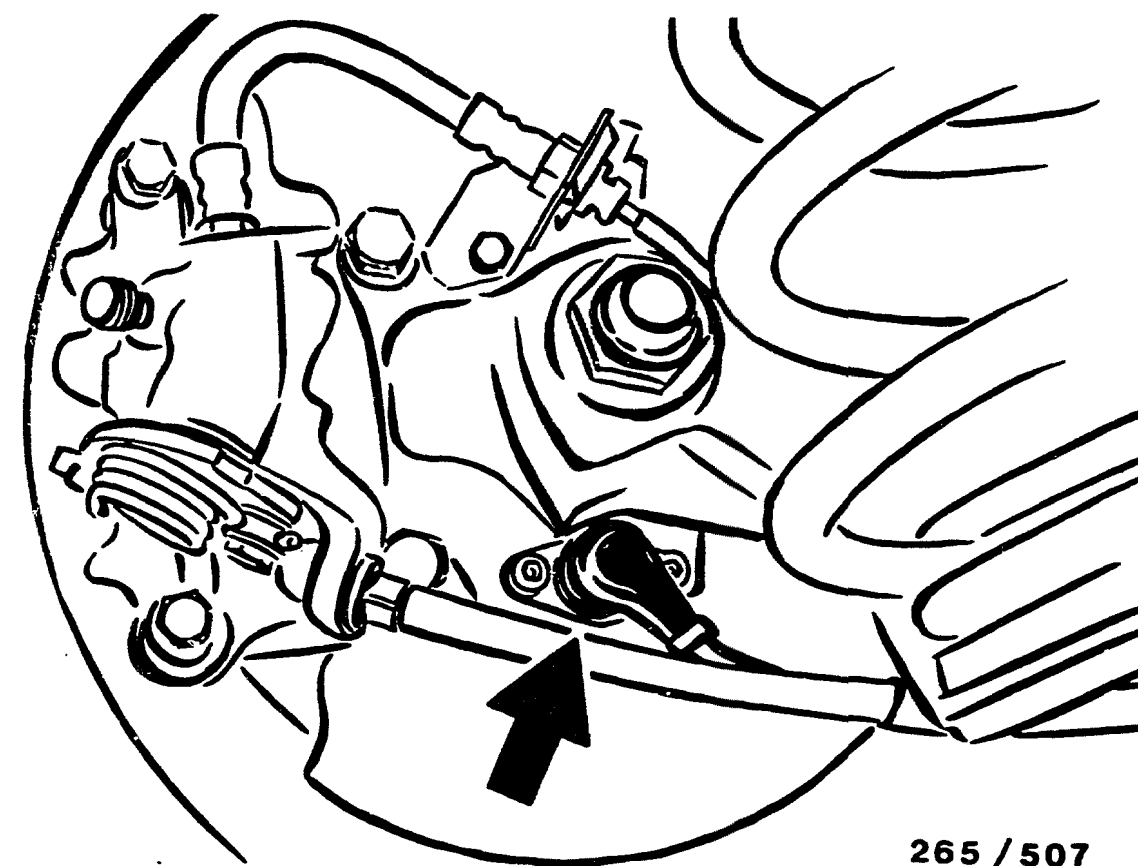


Arrow = Wheel-speed sensor, front

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Wheel-speed sensor, front axle:  
One each on left and right in steering knuckles.

Wheel-speed-sensor plug connections:  
In engine compartment on left on spring-strut dome and on right on side of spring-strut dome.



Arrow = Wheel-speed sensor, rear

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Wheel-speed sensor, rear axle:  
One each on left and right at wheels.  
2 thick shim rings are fitted beneath the wheel-speed sensors.

Wheel-speed-sensor plug connections:  
On left and right beneath rear seat bench.

BOSCH system	:	ABS
Make of vehicle	:	JAGUAR
Basic microcard	:	PKW-063

Section	Coordinates
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Special features .....	02
Structure, usage .....	03
Safety and precautionary measures .....	03
Test requirements .....	05
Rapid diagnosis chart .....	07
Test specifications .....	19
Electrical terminal diagram .....	21
Installation position of components, notes on removal and installation .....	23

**This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:**

**Jaguar XJ 6 3.6, Daimler 3.6, Sovereign 3.6  
Jaguar XJS 3.6 Coupe, Convertible**

- \* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- \* Brake-circuit arrangement on axle basis.
- \* Sensor ring gears with 48 teeth.
- \* Wheel-speed-sensor test:

The non-disconnectable differential lock means that the wheels at the rear axle cannot be turned by hand or only with great difficulty.

Do not drive rear axle with brake dynamometer for wheel-speed-sensor testing.

Jack up vehicle, move selector lever to N and let engine run. Both wheels of rear axle turn.

Set switch for wheel selection on ABS2 LED-tester to wheel to be tested.

After testing the wheel-speed sensors, they must be checked for possible mix-ups whilst the vehicle is still jacked up.

### Mix-up test:

Consecutively move wheels at rear axle back and forth by hand as far as they will go and observe indication on tester. LED flickers or pointer deflects slightly.

## STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

### ATTENTION :

The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

## SAFETY AND PRECAUTIONARY MEASURES

\*For reasons of safety, the hydraulic modulator must not be repaired, but may be exchanged only as a complete unit.

Exception: relays

\*Do not loosen any screws on the hydraulic modulator! Danger of fatal accident owing to failure of the brakes.

\*Take great care when handling brake fluid.  
Poison!

For further information, see brief instructions.

For production reasons:  
continued on the following  
coordinate.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 8 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. — and term. —.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!  
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.  
Repeat the complete test program after any repairs are carried out.  
The Antiskid System is a vehicle safety system.  
Work on the system demands detailed knowledge of the system.  
The conventional brake system must be O.K.

### General information for trouble-shooting:

Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

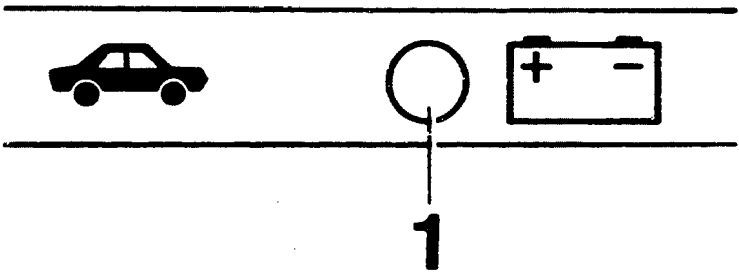


RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch positions 1 - 6

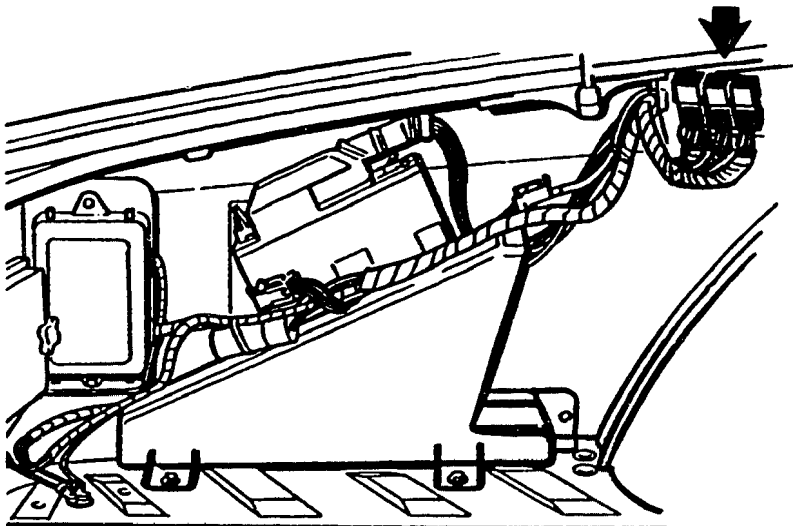
Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of trouble
Voltage supply  (Term.1 and term.20)	Ignition on	LED 1 (Top picture) lights up constantly	<ul style="list-style-type: none"><li>* Battery not sufficiently charged</li><li>* Excessive voltage dips.</li><li> </li><li>* Check leads from relay plug to controller term.1, to driving switch term.15, to battery B+ and to ground terminal. Check ground lead to controller term.20.</li><li> </li><li>* Over-voltage protection relay defective.</li></ul>



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1 = LED for supply voltage

Arrow = Overvoltage-protection relay

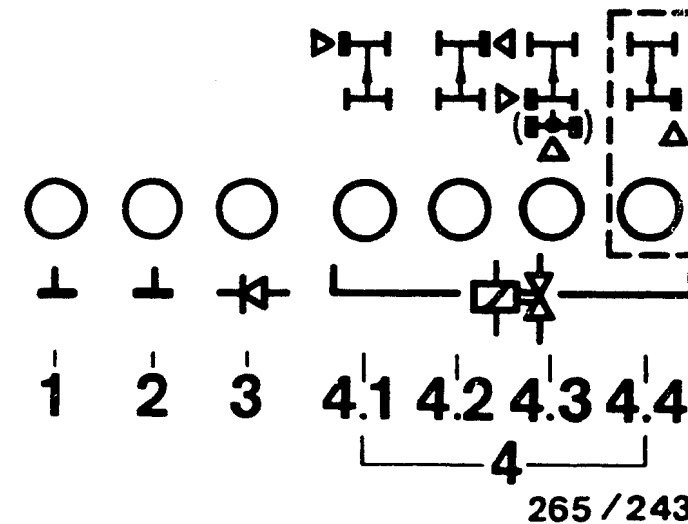


265 / 0638

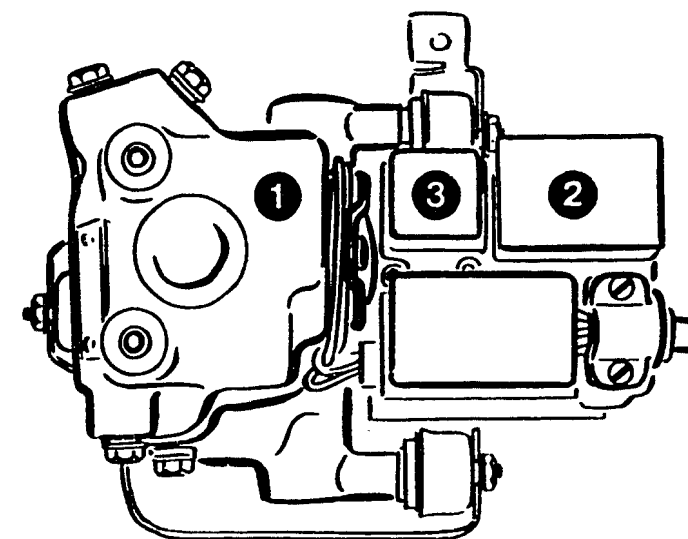
### RAPID DIAGNOSIS CHART (CONTINUED)

**Program-switch position 1 (3-channel hydraulic modulator)**

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)	Ignition on	6 LED (1 to 4.3)	* LED 1 and/or 2 (top picture) not lit:
Diode for warning lamp (term.29, term.32)		simultaneously brightly lit (top picture)	Check ground terminals for open circuit.
Solenoid-operated valve internal res. (term.2, term.35, term.-, term.18)		ABS warning lamp in vehicle must light up	* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.
Off-position and ground connection of relay			* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.
ABS warning lamp			Solenoid-operated valve internal resistance 0,7...1,7 $\Omega$
			* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.
			* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.
			* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



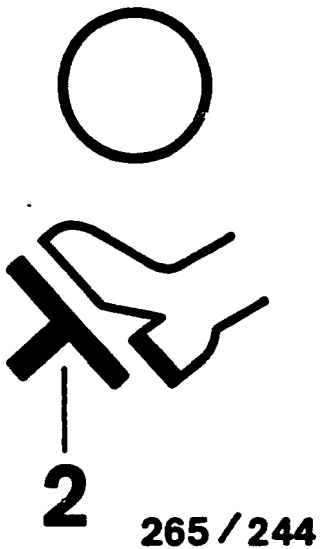
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

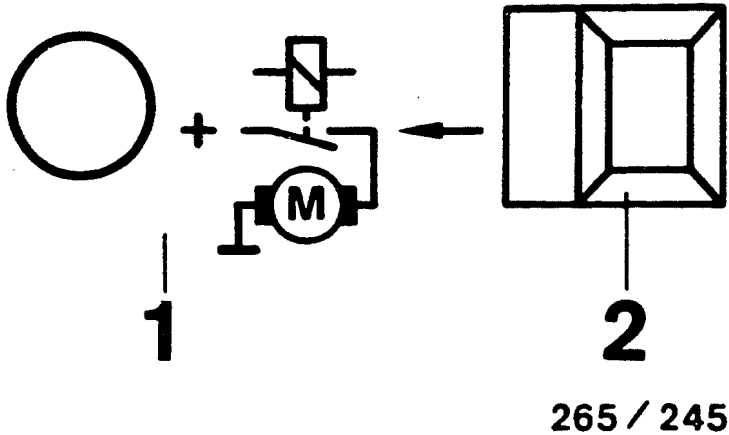
Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



RAPID DIAGNOSIS CHART (CONTINUED)

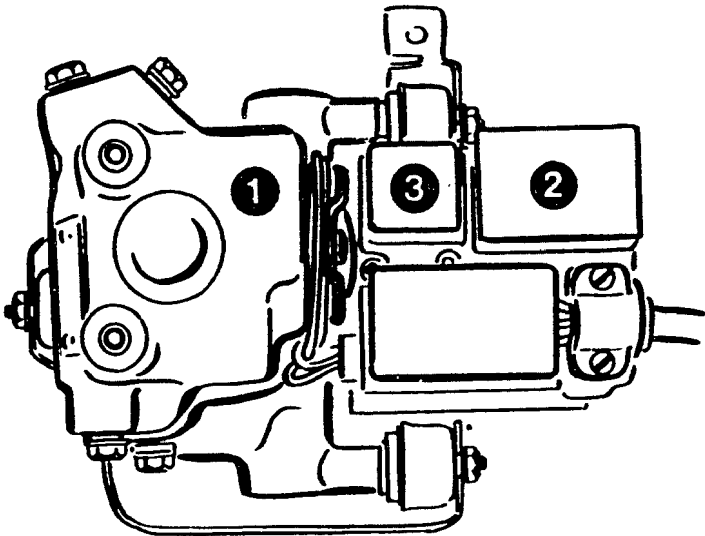
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs.  After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Test ground connection and positive terminal of pump motor</li><li>* Test following leads:  From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 10 and term. 12.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



Program-selector-switch position 4 does not apply.

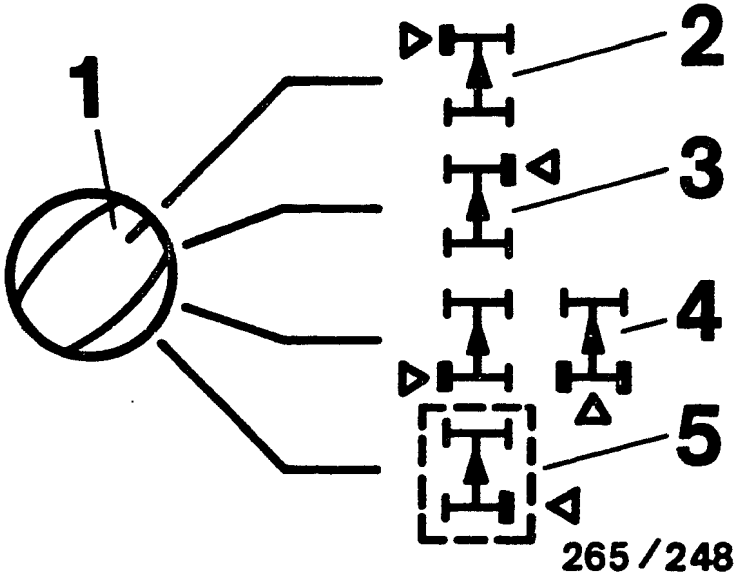
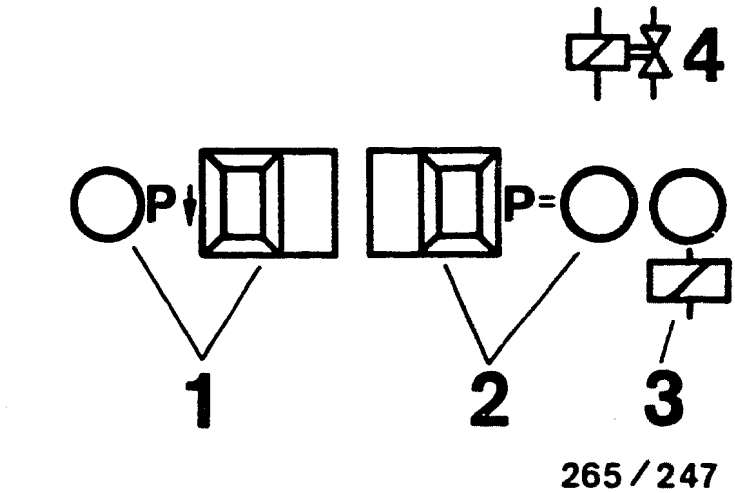
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



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RAPID DIAGNOSIS CHART (CONTINUED)  
 Program-selector-switch position 5 (3-channel hydraulic modulator)

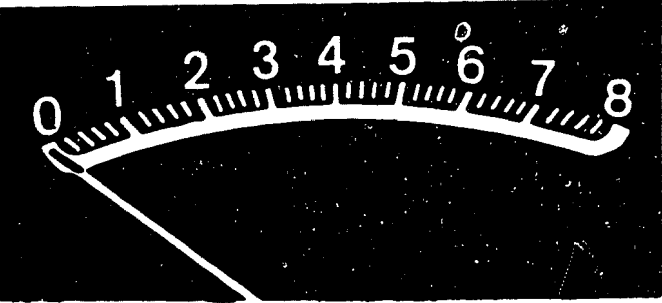
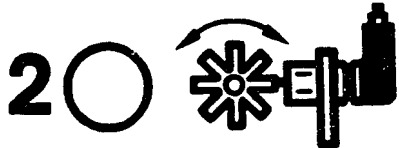
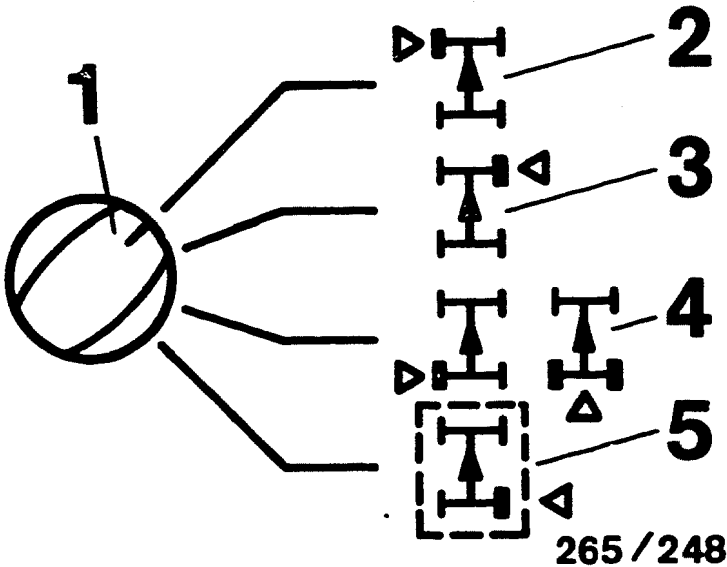
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.— Wheel, rear right: term.— Rear axle: term.18 * Hydraulic modulator defective
	5.Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6.Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
<p>Wheel-speed sensors for proper func- tioning and mix-up</p> <p>NOTE: Perform test consecutively for each individual wheel. Important: Refer to "Special features" when testing wheel-speed sensors at rear axle, since wheels cannot be turned by hand on account of differential lock</p> <p>Wheel, front left: t. 6 and t. 4</p> <p>Wheel, front right: t. 11 and t. 21</p> <p>Wheel, rear left: t. 8 and t. 9</p> <p>Wheel, rear right: t. 24 and t. 26</p>	<p>Jack up vehicle. Ignition on.</p> <p>It must be possible to turn the wheel to be tested freely by hand</p> <p>The wheel not being tested must be held when testing the driven axle.</p> <p>Set switch for wheel selection to wheel to be tested (bottom picture)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Then read off indication on instrument: (top picture)</p>	<p>1. Smallest reading greater than 1,6 scale divisions</p> <p>2. Permissible fluctuation max. 25 % from maximum displayed value.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Open circuit in wheel- speed-sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance: Front axle: 0,6...1,6 k <math>\Omega</math> Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too large</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with wrong number of teeth fitted Front axle: 48 teeth Rear axle : 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Indication given, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.</p>



Continue testing on next Coordinate.

## TEST SPECIFICATIONS

## Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:  
rear axle:

600...1600 Ω  
600...1600 Ω

## Hydraulic-modulator solenoid-operated valves

- \* Winding resistance at ambient temperature ( $-10^{\circ}\text{C} \dots +120^{\circ}\text{C}$ ):

 $0,7 \dots 1,7 \quad \Omega$ 

### Air gap between wheel-speed sensor and ring gear

- ```
* at front wheels : slide in wheel-speed sensor
                    as far as it will go
* at rear wheels  : slide in wheel-speed sensor
                    as far as it will go
```

## Tightening torque for

- \* Fastening screws of the wheel-speed sensors:

**> 8 Nm**

- \* Brake-line connections on the hydraulic modulator:

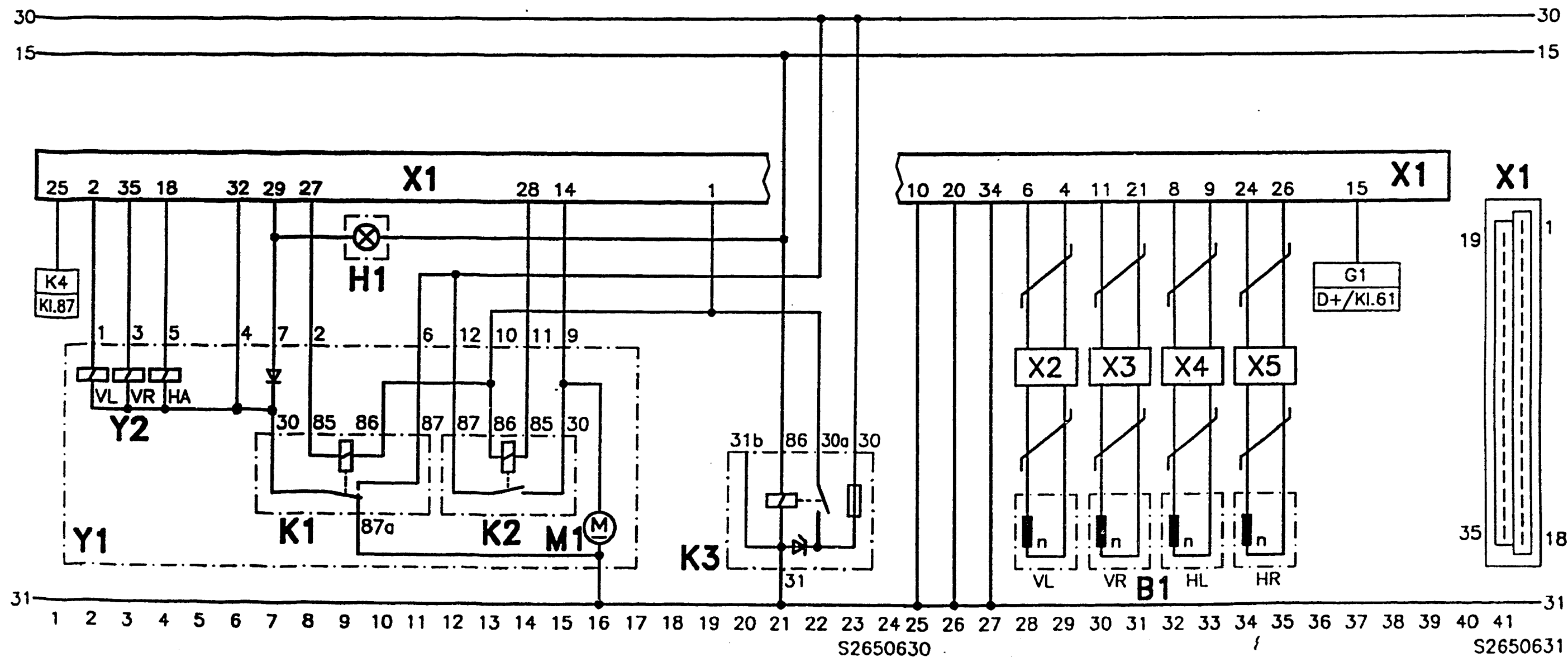
**12...16 Nm**

Number of teeth on wheel-speed-sensor  
ring gears

- ```
* Front axle:
* Rear axle:
```

48 teeth  
48 teeth

For production reasons:  
continued on the following  
coordinate.



# ELECTRICAL TERMINAL DIAGRAM

B1 = Wheel-speed sensor  
G1 = to alternator  
H1 = ABS warning lamp  
K1 = Valve relay  
K2 = Motor relay  
K3 = Over-voltage protection relay  
K4 = Stop-lamp simulation relay

M1 = Return-pump motor  
S1 = Stop-lamp switch  
X1 = Controller plug (35-pole)  
X2...X5 = Multiple butt connector  
Y1 = Hydraulic modulator  
Y2 = Solenoid valves

VL = Front left  
VR = Front right  
H = Rear axle  
HL = Rear left  
HR = Rear right

L21

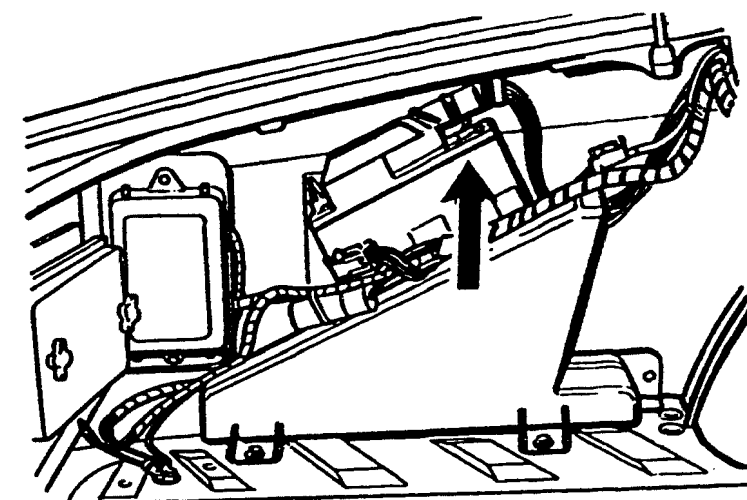
L22



## INSTALLATION POSITION OF COMPONENTS

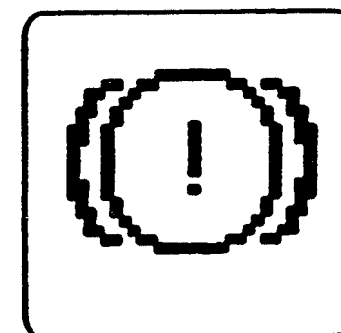
The stated installation locations always refer to the direction of travel.

- \* Controller: arrow, top picture  
In trunk on left-hand side behind trim



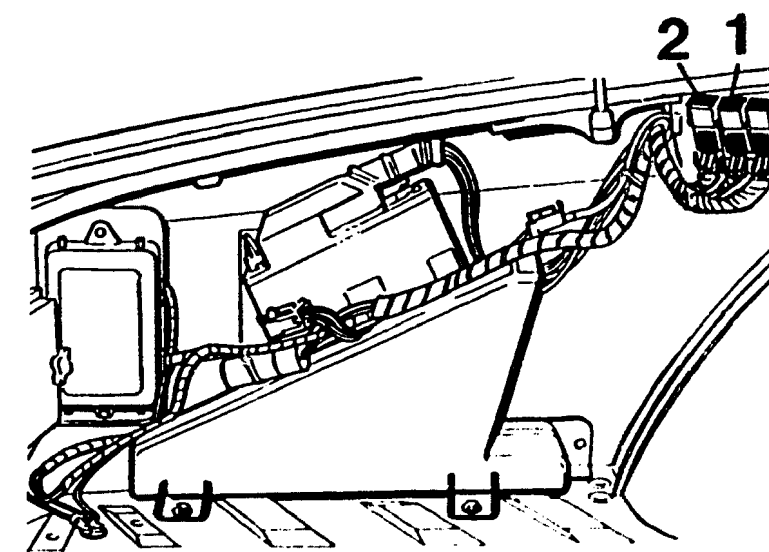
265/0632

- \* ABS warning lamp: symbol, center picture  
A symbol with a yellow border and beneath it the words ANTI LOCK FAILURE are displayed on the right-hand side of the instrument panel:



265/0634

- \* Over-voltage protection relay 1 : bottom picture  
Stop-lamp simulation relay 2 : bottom picture  
In trunk on left-hand side above wheel arch.



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## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

### \* Hydraulic modulator: top picture

In engine compartment in direction of travel, right in vicinity of bulkhead.

The hydraulic modulator is not to be repaired, but rather only replaced as a complete unit.  
Exception: relay change.

### \* ABS ground terminal: not illustrated

In trunk, left in vicinity of ABS controller.

### \* Wheel-speed sensor, front axle: center picture

One wheel-speed sensor each on inside (anchor plate) of left and right front wheel.

Insert wheel-speed sensor as far as it will go into hole, do not knock into position.

Wheel-speed-sensor plug connections:

In direction of travel, left and right on fender in vicinity of bulkhead.

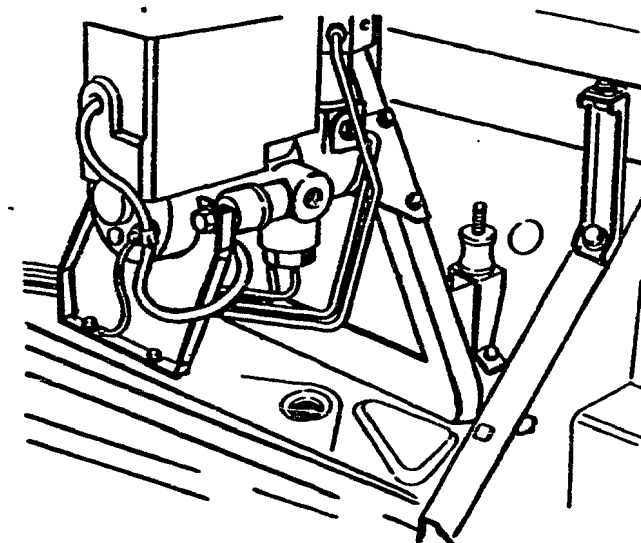
### \* Wheel-speed sensor, rear axle: bottom picture

One wheel-speed sensor each inserted from above into axle beam of left and right rear wheel.

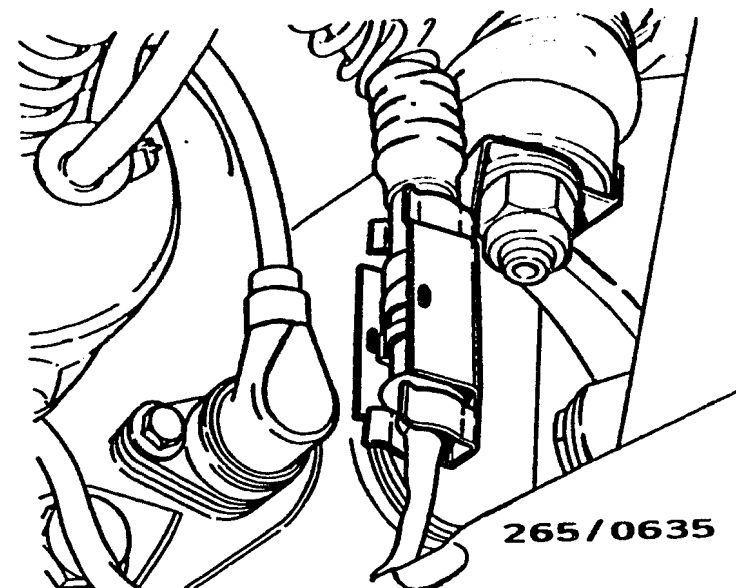
Insert wheel-speed sensor as far as it will go into hole, do not knock into position.

Wheel-speed-sensor plug connections:

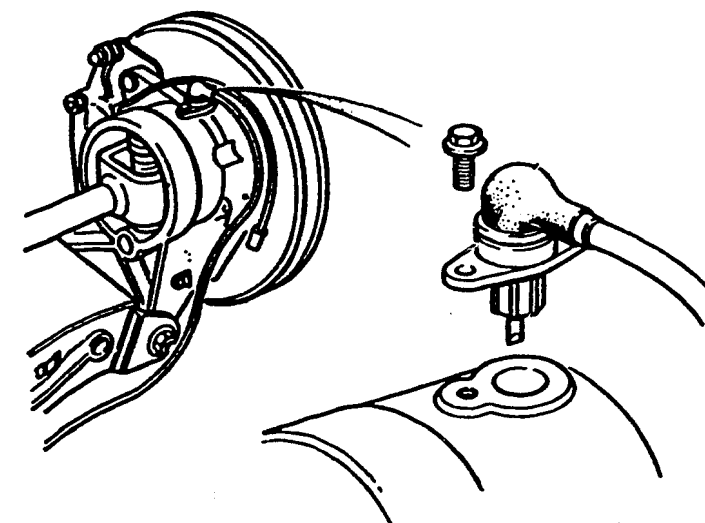
On left and right behind front lining in trunk.



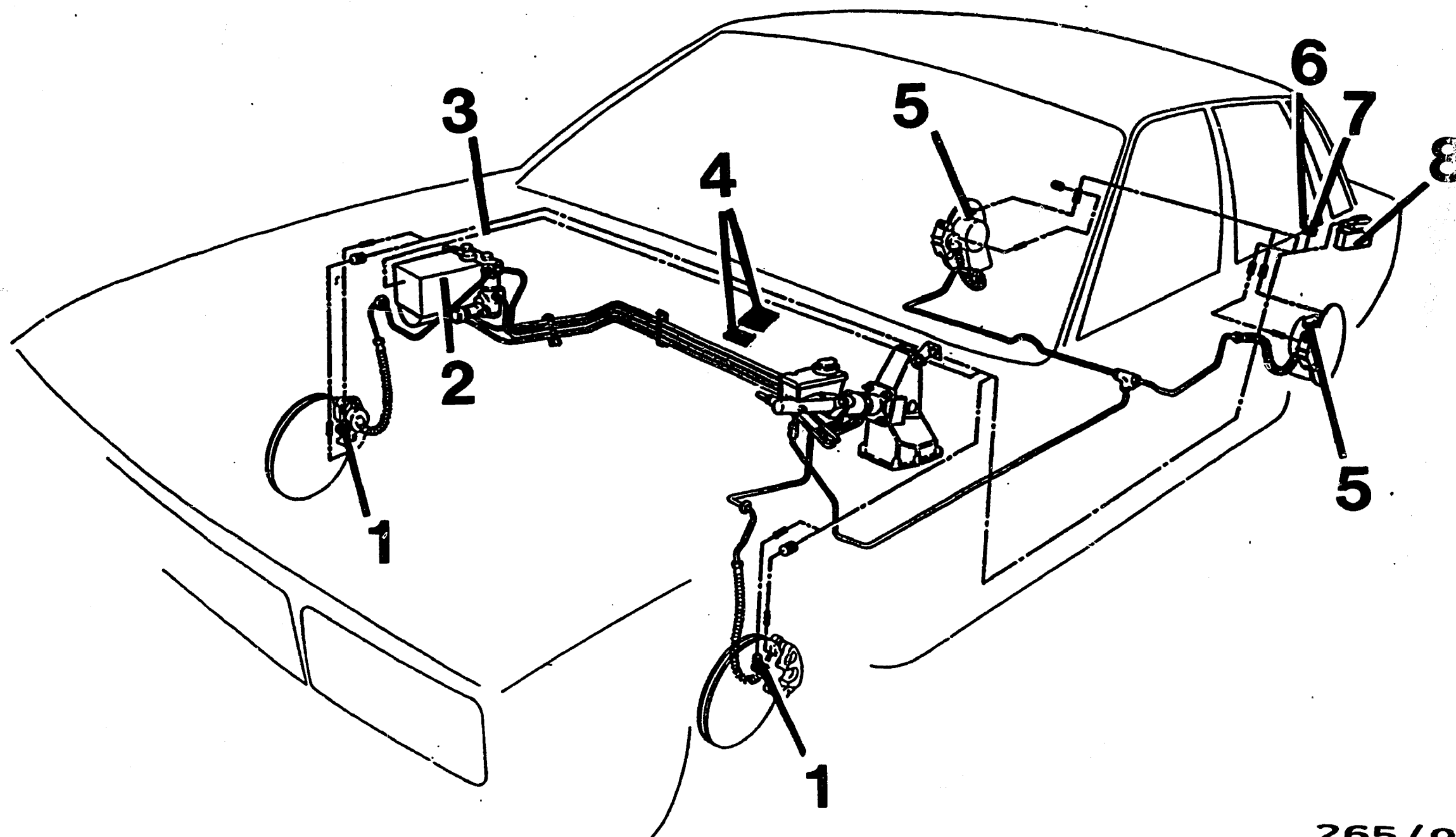
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265/0639

# INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Wheel-speed sensors, front axle
- 2 = Hydraulic modulator
- 3 = ABS wiring harness
- 4 = ABS warning lamp (symbol and text)

- 5 = Wheel-speed sensors, rear axle
- 6 = Over-voltage protection relay
- 7 = Stop-lamp simulation relay
- 8 = ABS controller

Trouble-shooting instructions : LAI-5002

BOSCH system : ABS

Make of vehicle : LANCIA

Basic microcard : PKW-040

TABLE OF CONTENTS

Section	Coordinates
Special features .....	02
Structure, usage .....	02
Safety and precautionary measures .....	02
Test requirements .....	03
Rapid diagnosis chart .....	04
Test specifications .....	17
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Installation position of components, notes on removal and installation .....	21

SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

Lancia Thema 8.32 (with Ferrari engine)  
1.1988 ->

- \* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
- \* Sensor ring gear with 90 teeth.
- \* Adjust wheel-speed sensors on all wheels if necessary with shims.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- \* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.  
Exception: relays.
- \* Do not loosen any screws on the hydraulic modulator!  
Danger of fatal accident due to brake failure.
- \* Caution when handling brake fluid.  
Poisonous!

For further information, see basic instructions.

TEST REQUIREMENTS FOR TESTING WITH  
ABS2 LED TESTER

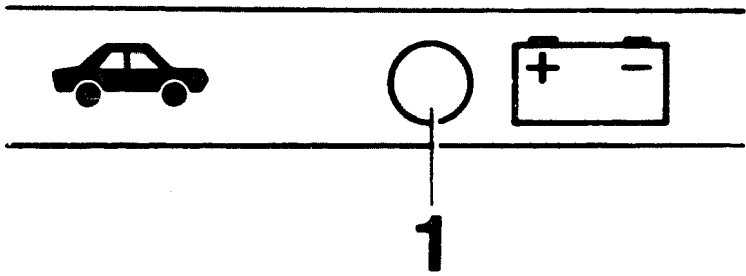
- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

RAPID DIAGNOSIS CHART

Do not drive with tester connected! Have all test prerequisites been satisfied?

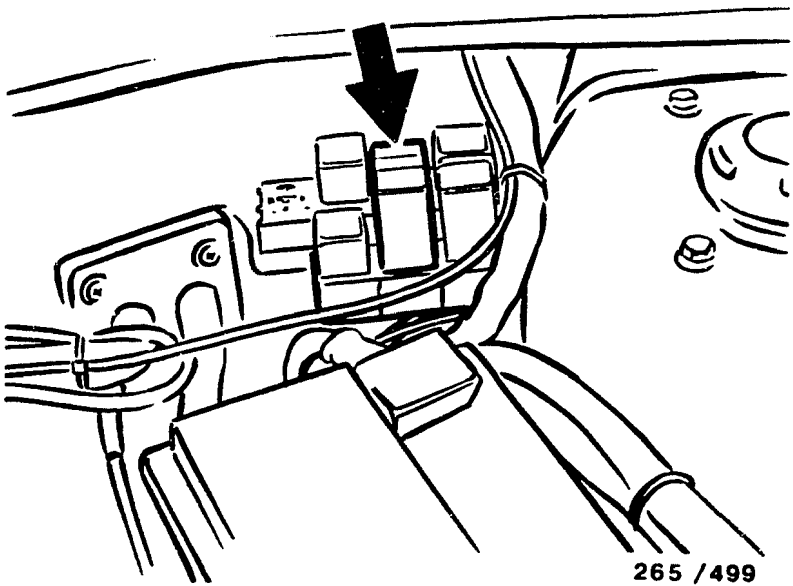
Program-selector-switch settings 1 -- 6

Testing of (Measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (Term.1 and term.20)	Ignition on	LED 1 (top picture) lights up continuously	<ul style="list-style-type: none"><li>* Fuse defective.</li><li>* Inadequate battery charge.</li><li>* Excessive voltage dips.</li><li>* Test lead to driving switch, term. 15.</li><li>* Over-voltage protection relay defective.</li></ul>



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Arrow = Over-voltage protection relay

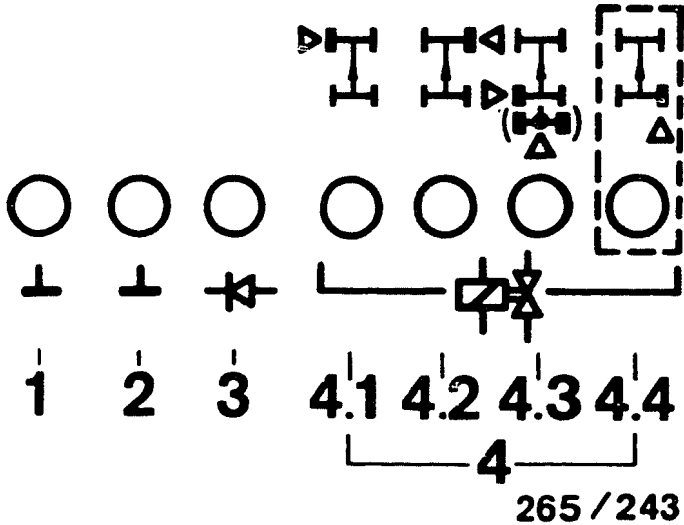


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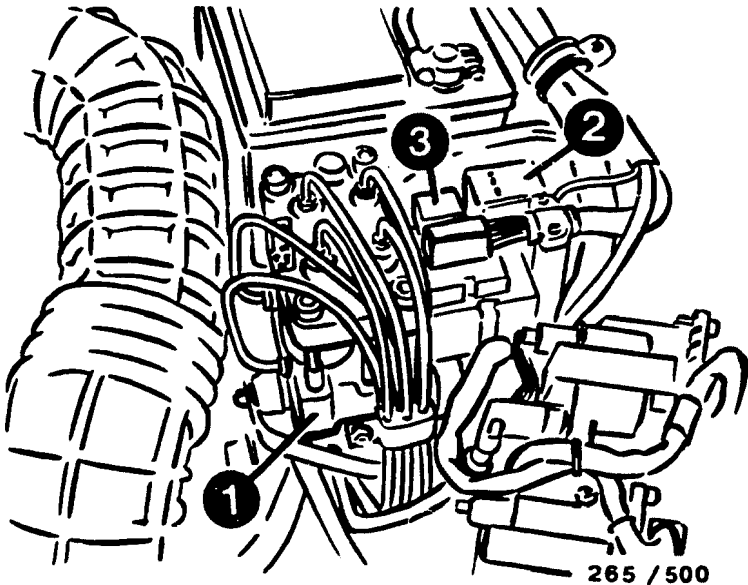
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.19, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	7 LED (1 to 1.4)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.  * LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.  * One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.  Solenoid-operated valve internal resistance 0,7...1,7 $\Omega$  * All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.  * Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.  * ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



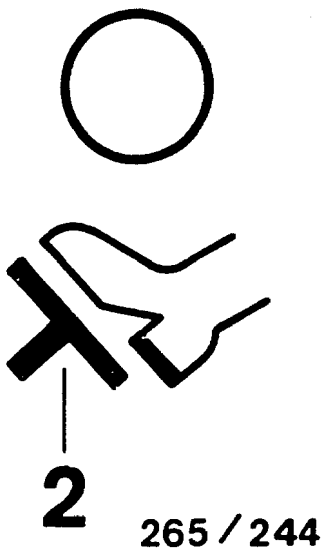
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

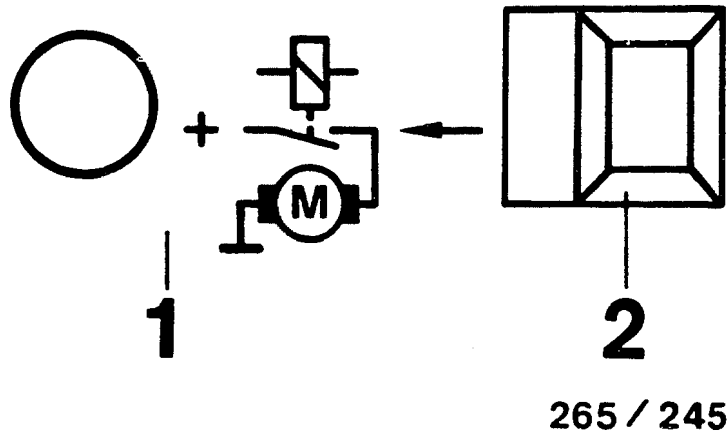




RAPID DIAGNOSIS CHART (CONTINUED)

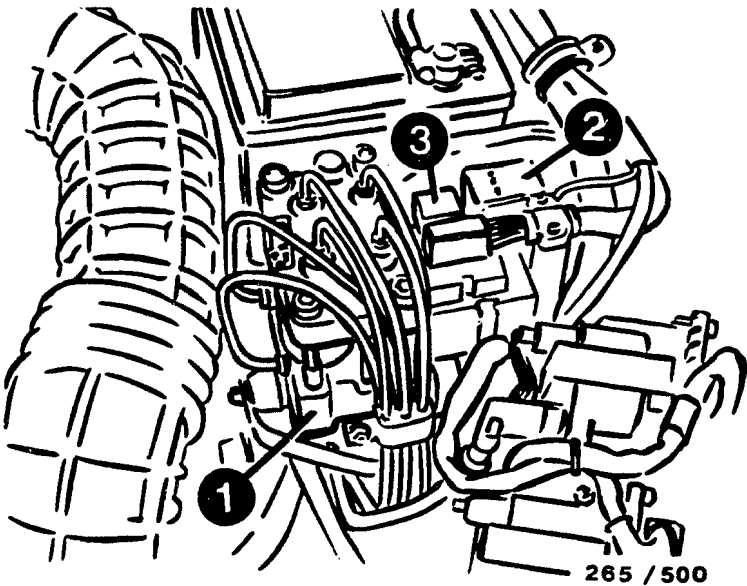
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs.  After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Test ground connection and positive terminal of pump motor</li><li>* Test following leads:  From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 2 and term. 13.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



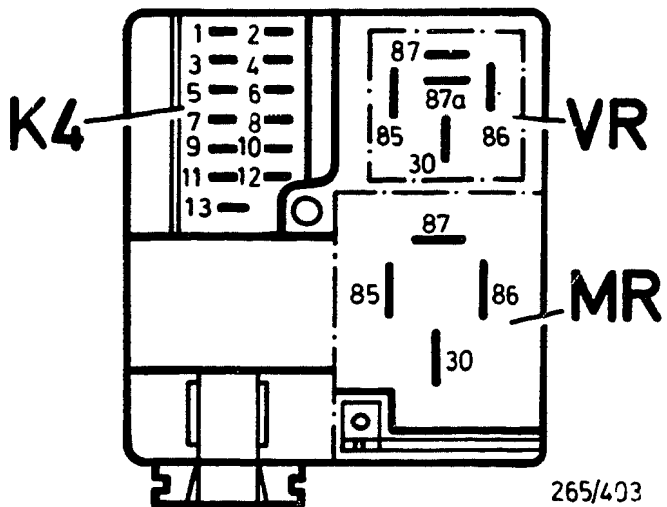
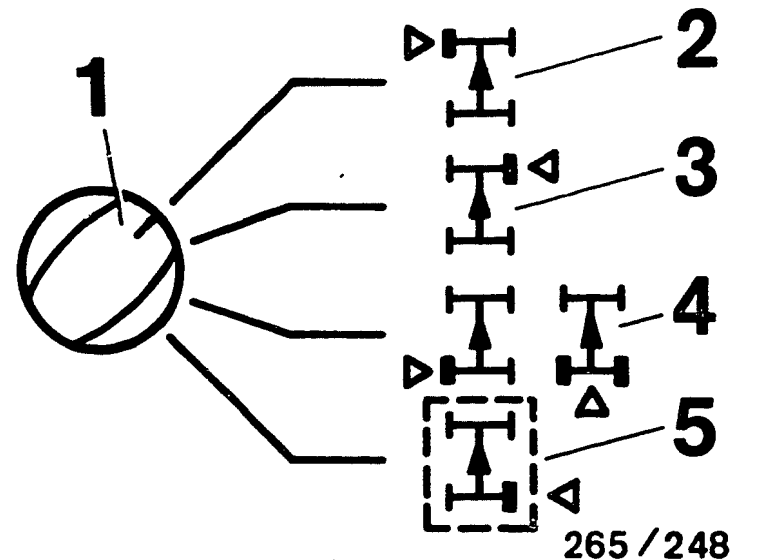
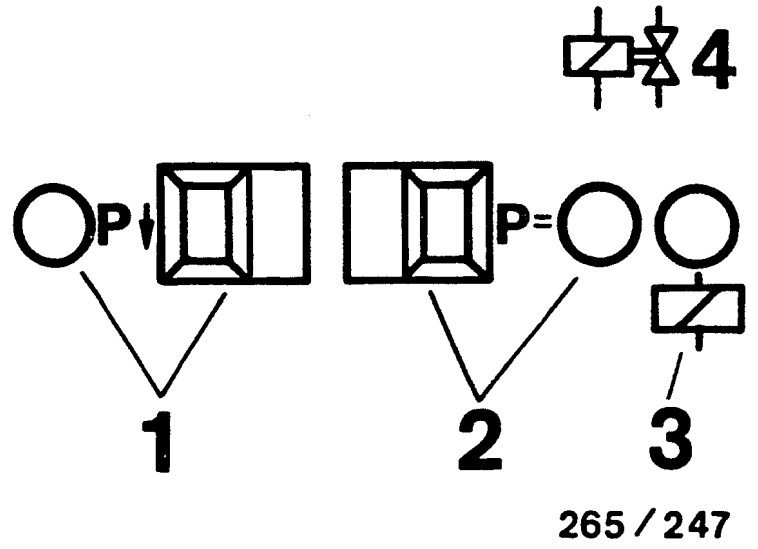
Program-selector-switch position 4 does not apply.

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (4-channel hydraulic modulator)

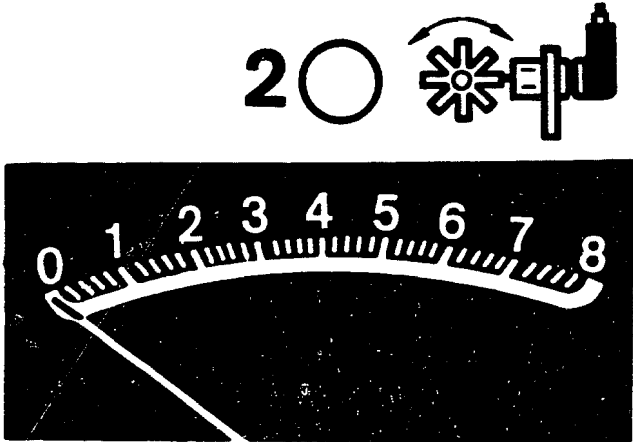
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valves in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence.	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested (center illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in lead from valve relay term. 87 to B+  * Brake leads at hydraulic modulator mixed up
Operation, pressure holding	1. Constantly press push-but. P = (upper illustration)	LED P= (upper illustration) lights up)	* Current value not obtained (LED P arrow or P= goes out; upper illustration); battery insufficiently charged. Repeat check with engine running.
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P = (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation, pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-operated valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term. 35 Wheel, rear left: term. 18 Wheel, rear right: term. 19 Rear axle: term. —  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

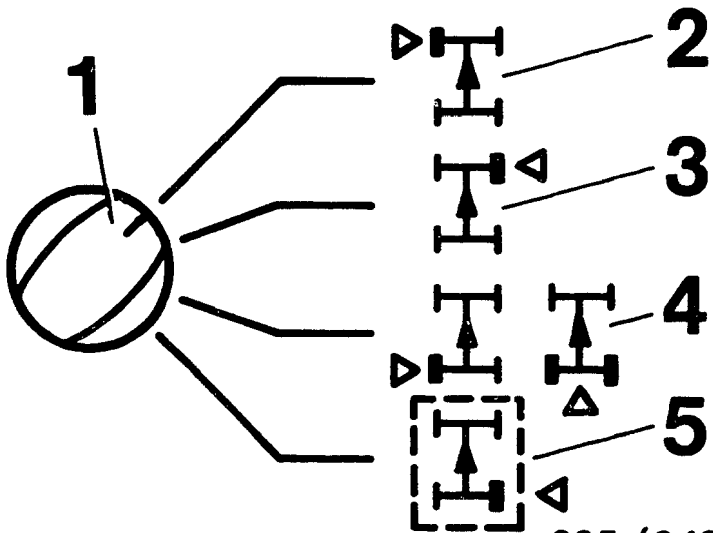
Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.4 and t.5</p> <p>Wheel, front right: term.11 and term.21</p> <p>Wheel, rear left: term.7 and term.9</p> <p>Wheel, rear right: term.24 and term.26</p>	<p>Chock-up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turn- able by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1. Smallest reading larger 1,0 divisions</p> <p>2. Permissible fluctuation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Brake in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math></p> <p>Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel- speed sensor and ring gear too wide</p> <p>*Ring gear defective (e.g. corroded, dirty) or loose.</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 90 teeth Rear axle: 90 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Instrument gives reading, LED 2 does not light up: loose contact in wheel- speed sensor lead.</p>



1

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## TEST SPECIFICATIONS

## Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front wheels:  
rear wheels:

600...1600 Ω  
600...1600 Ω

## Hydraulic-modulator solenoid valves

- \* Winding resistance at ambient temperature ( $-10^{\circ}\text{C} \dots +120^{\circ}\text{C}$ ):

$0,7 \dots 1,7 \quad \Omega$

### Air gap between wheel-speed sensor and ring gear

- ```
* at front wheels:
* at rear wheels:
```

0,8 ± 0,5 mm  
0,8 ± 0,5 mm

### Tightening torque for

- \* fastening screws of wheel-speed sensors:**

**> 8 Nm**

- \* Brake-line connections at hydraulic modulator:**

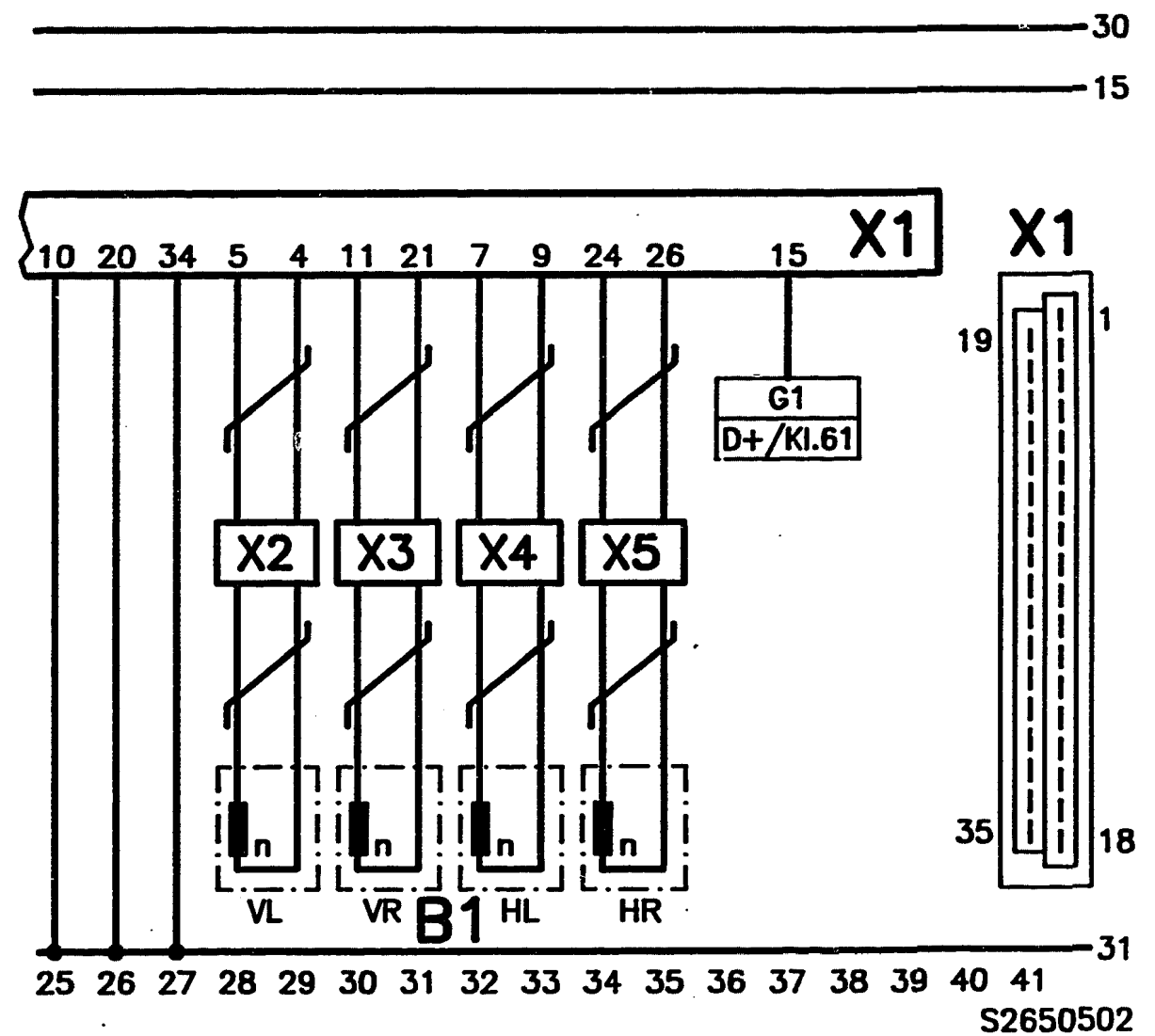
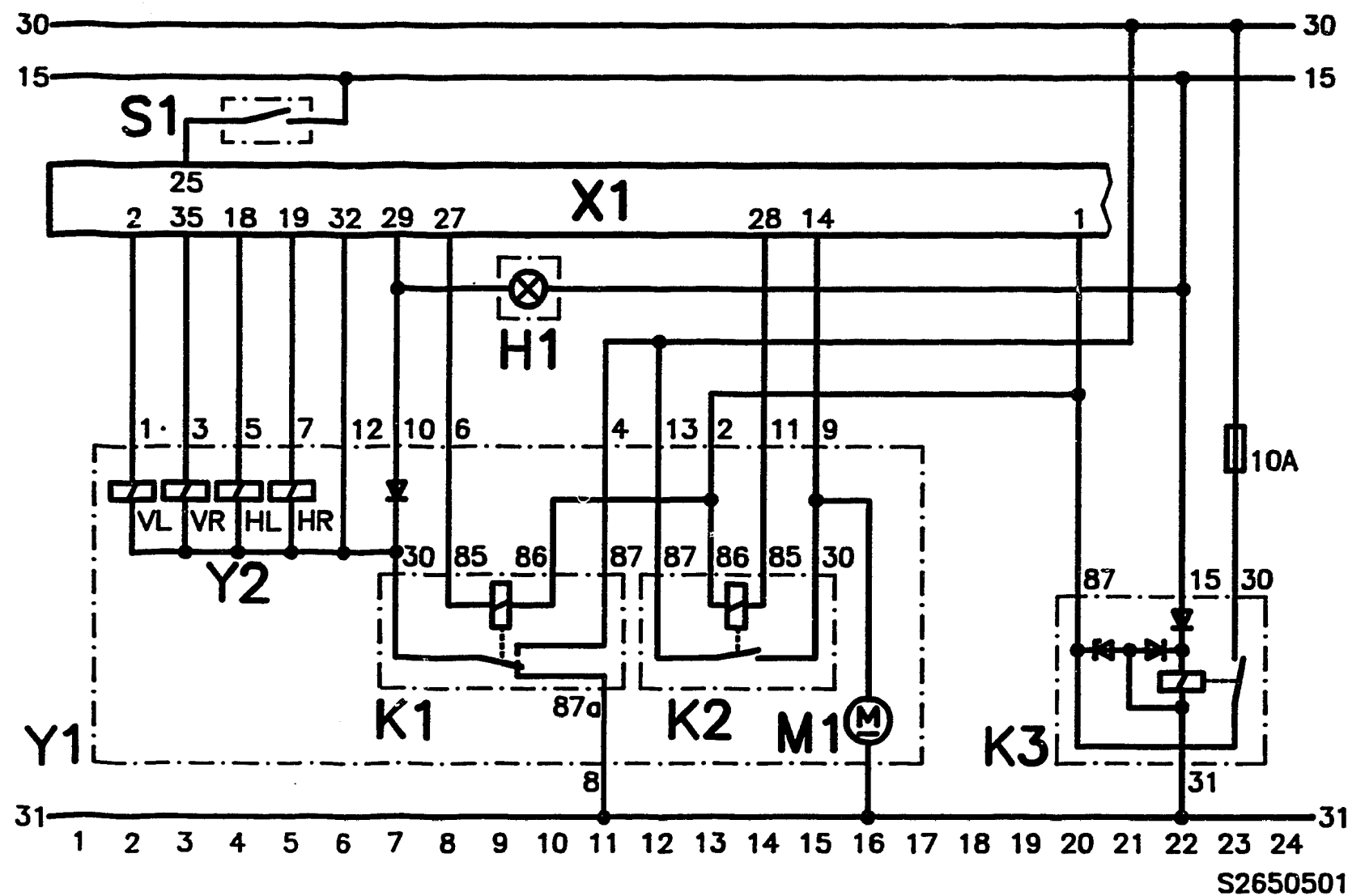
**12...16 Nm**

### Number of teeth on ring gears of wheel-speed sensors

- ```
* at front wheels:
* at rear wheels:
```

90 teeth  
90 teeth

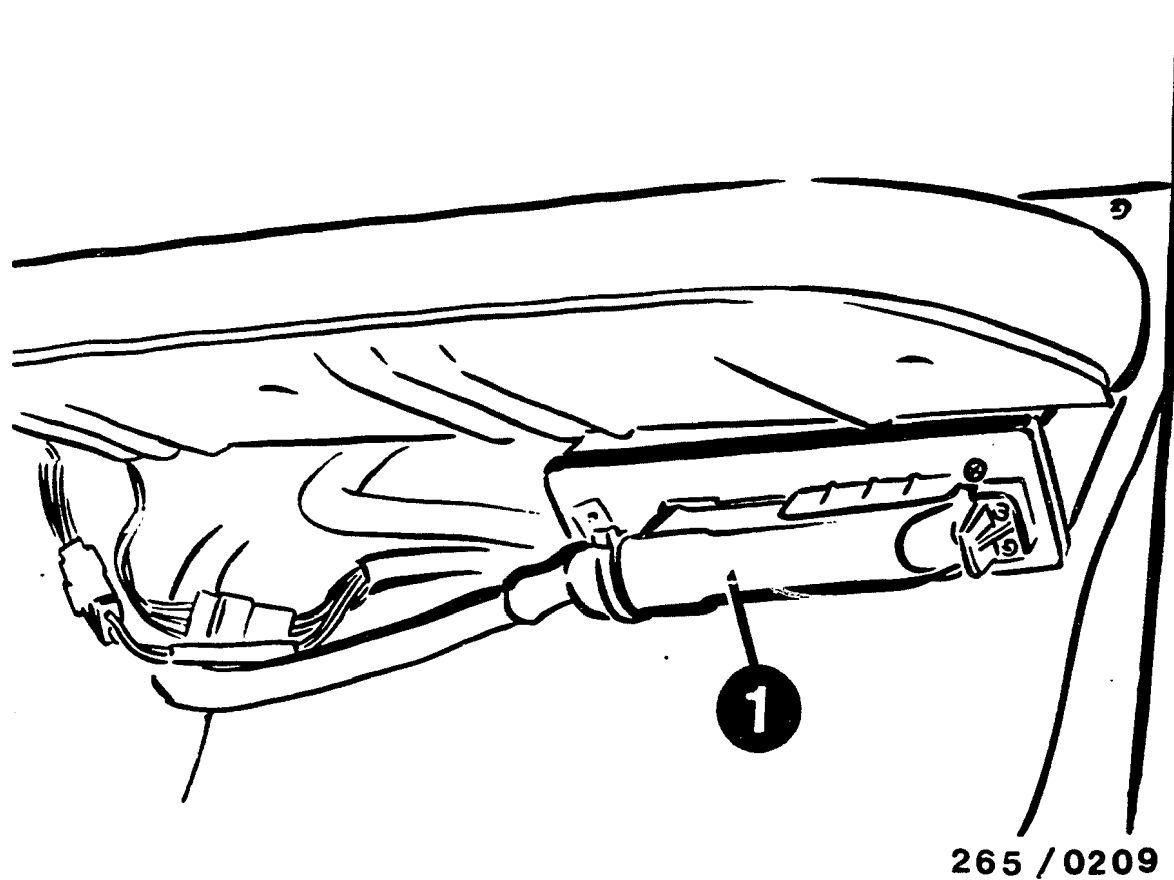
For production reasons:  
continued on the following  
coordinate.



# ELECTRICAL TERMINAL DIAGRAM

B1 = Wheel-speed sensor	M1 = Return-supply-pump motor
G1 = To alternator	S1 = Stop-lamp switch
H1 = ABS warning lamp	X1 = Controller plug (35-pin)
K1 = Valve relay	X2...X5 = Wheel-speed-sensor plug
K2 = Motor relay	Y1 = Hydraulic modulator
K3 = Overvoltage-protection relay	Y2 = Solenoid-operated valves

HL = Rear left  
HR = Rear right  
VL = Front left  
VR = Front right

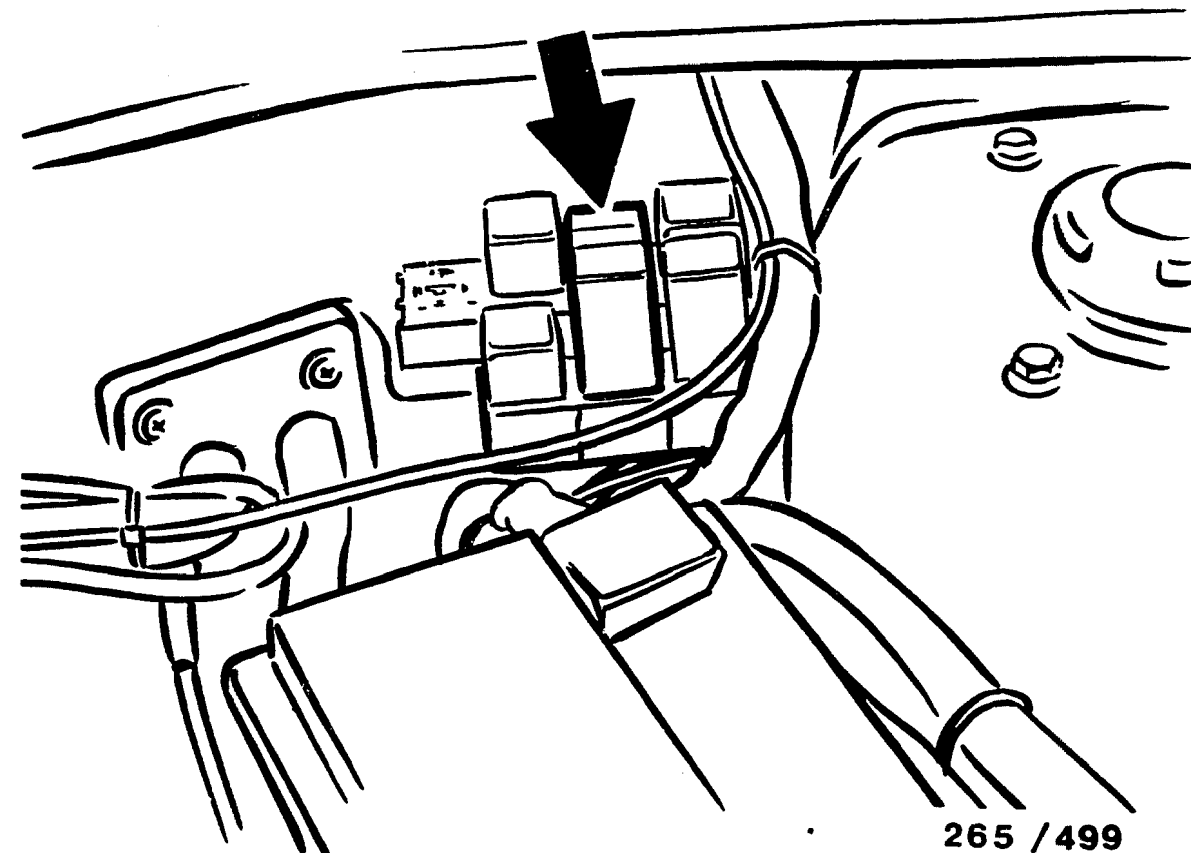


1 = ABS controller

#### INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

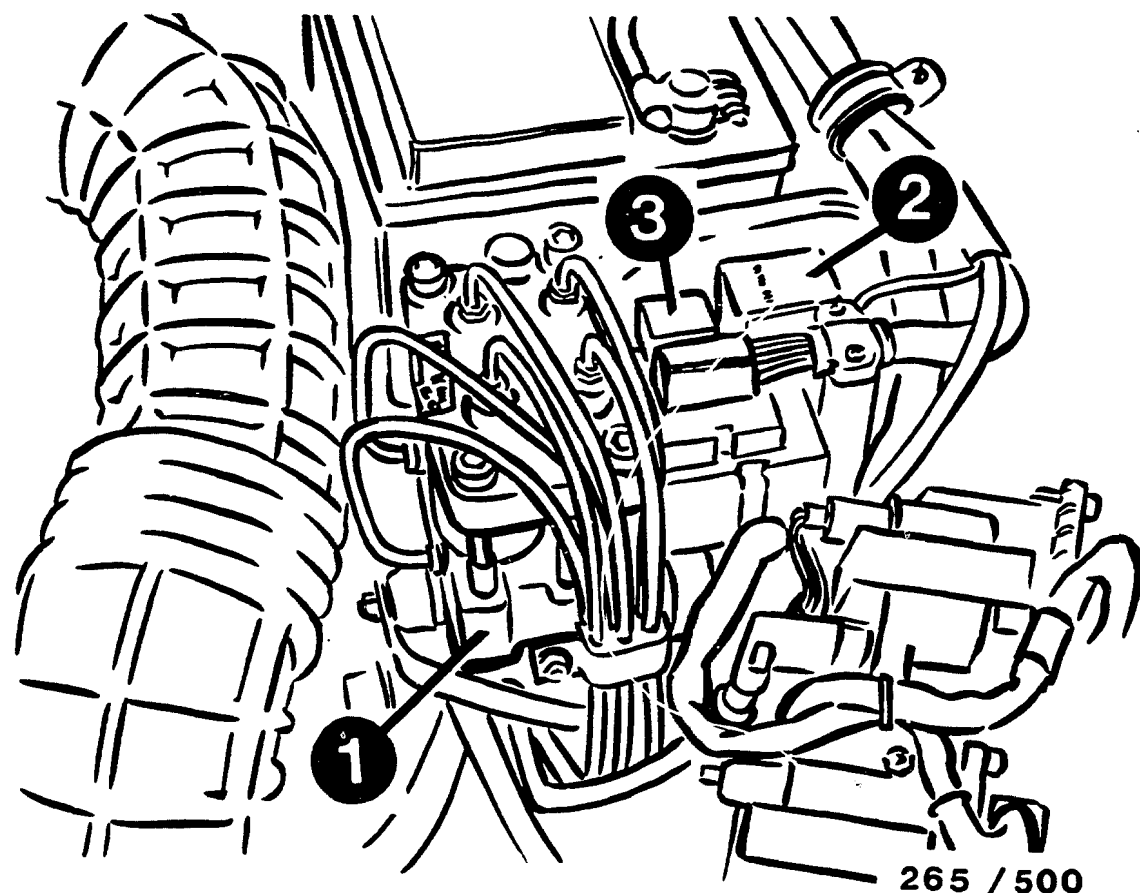
- \* Controller:  
In passenger-side footwell beneath glove compartment. Unscrew lower trim. Take care not to mix up ABS controller with KE-Jetronic control unit.
- \* ABS warning lamp: in instrument panel.  
Symbol: skidding car.
- \* Stop-lamp switch:  
at brake pedal.



Arrow = Over-voltage protection relay

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Over-voltage protection relay:  
In engine compartment on left at spring-strut dome.
- \* Ground terminal and positive terminal:  
In engine compartment at left-hand spring-strut dome beneath relay frames and located in a housing.



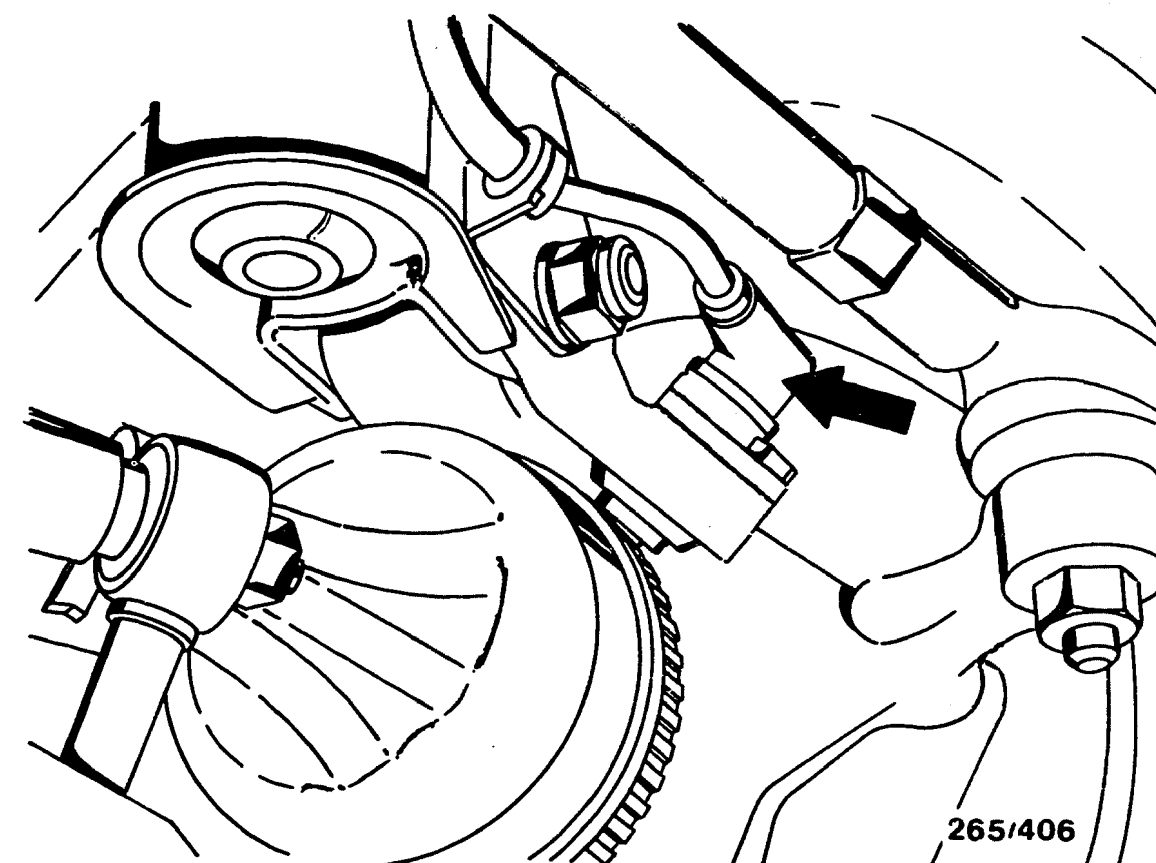
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

#### INSTALLATION POSITION OF COMPONENTS (Continued)

- \* Hydraulic modulator:  
in the engine compartment at the front on the left-hand side in front of the battery.

The hydraulic modulator must not be repaired, but be exchanged only as a complete unit.  
Exception: relays may be exchanged.

Make sure that the brake-line connections are not mixed up.

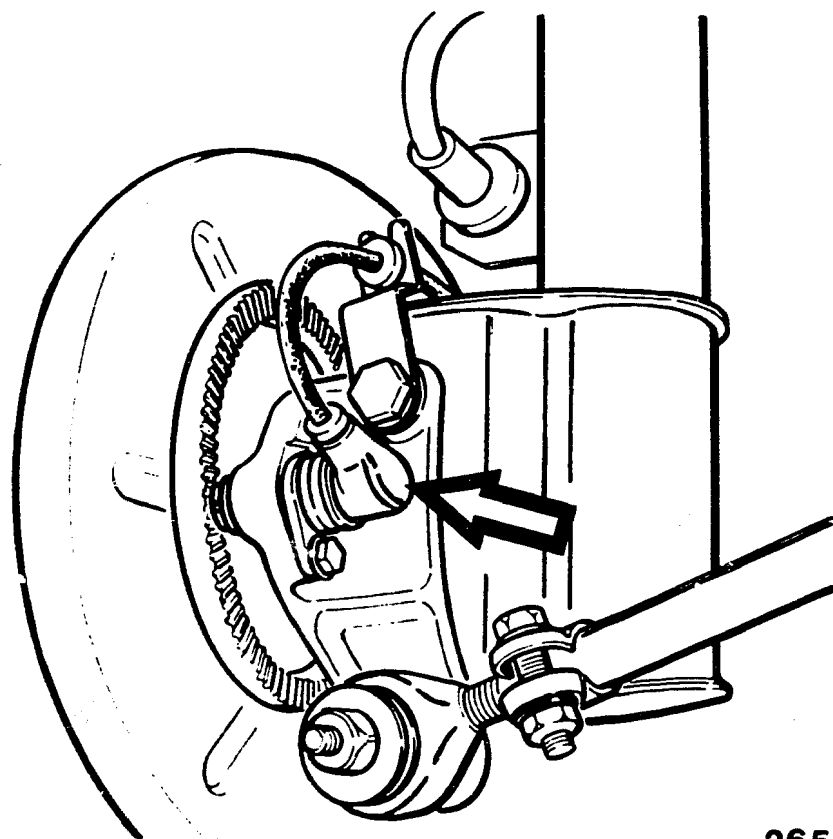


Arrow = Front wheel-speed sensors

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Front-axle wheel-speed sensors:  
One each on left and right in steering knuckles.  
Take care not to lose existing shims.  
Test air gap and correct if necessary with corresponding shims.

Wheel-speed-sensor plug connections:  
On left and right at wheelhouse in front of bulkhead.



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Arrow = Rear wheel-speed sensors

#### INSTALLATION POSITION OF COMPONENTS (continued)

- \* Rear-axle wheel-speed sensors:  
One each on left and right at wheels.

Take care not to lose existing shims.  
Test air gap and correct if necessary with  
corresponding shims.

Wheel-speed-sensor plug connection:  
On left and right in trunk in recesses  
behind side trim.

For production reasons:  
continued on the following  
coordinate.





## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 8 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!  
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.  
Repeat the complete test program after any repairs are carried out.  
The Antiskid System is a vehicle safety system.  
Work on the system demands detailed knowledge of the system.  
The conventional brake system must be O.K.

### General information for trouble-shooting:

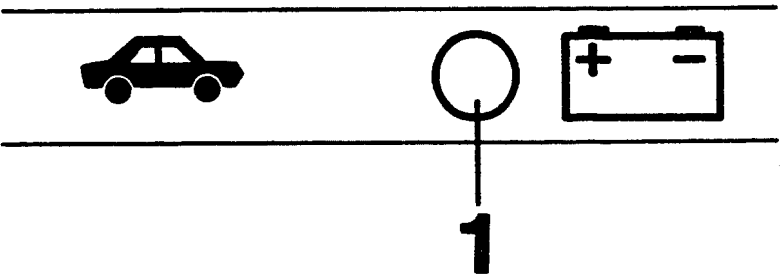
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

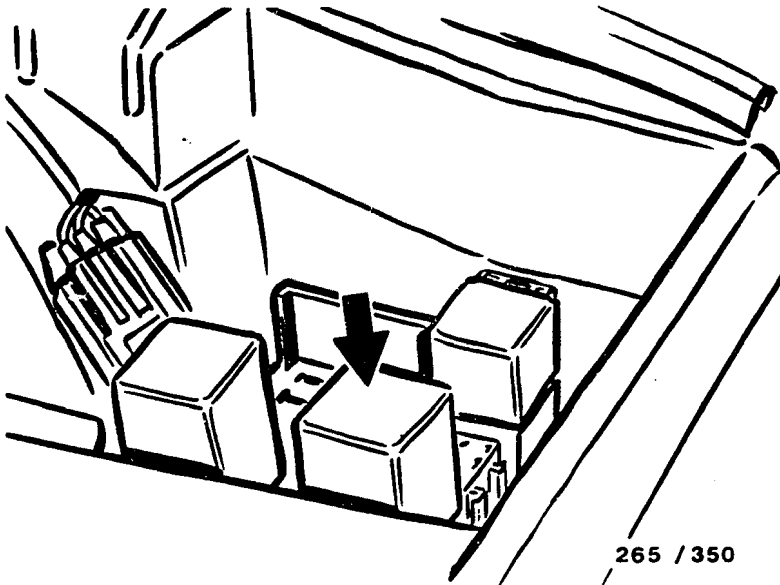
Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply  (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<div>*Battery insufficiently charged</div> <div>*High voltage drops</div> <div>*Overvoltage-protection relay defective</div> <div>*Check lead to ignition and starting switch, term. 15</div>



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1 = LED for supply voltage

Arrow = Overvoltage-protection relay

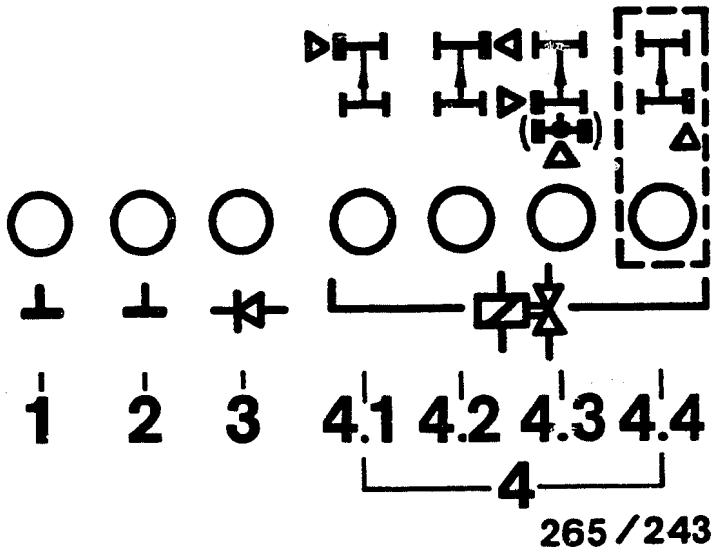


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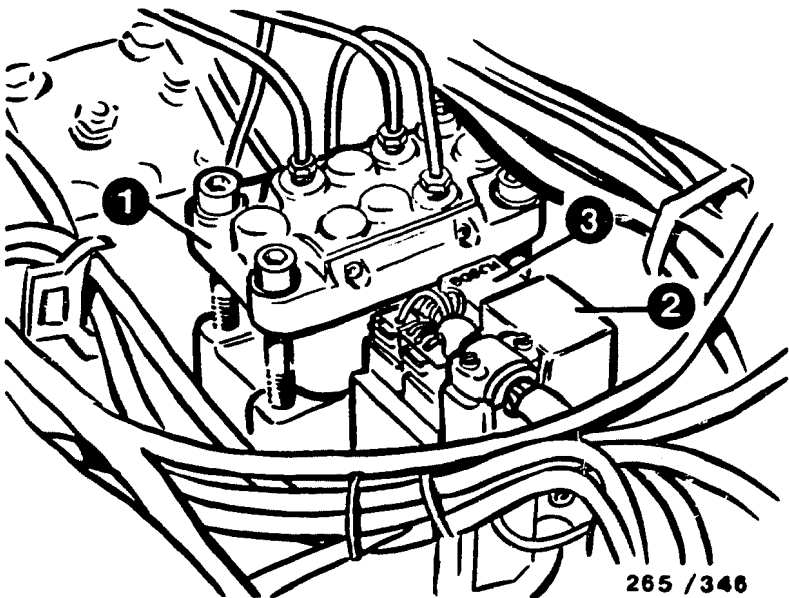
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 Ω</li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



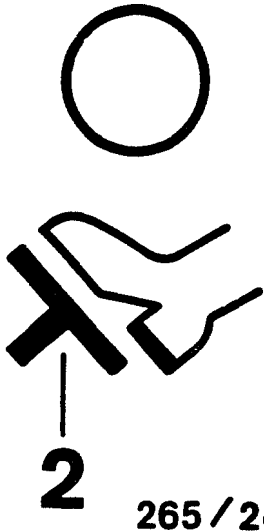
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

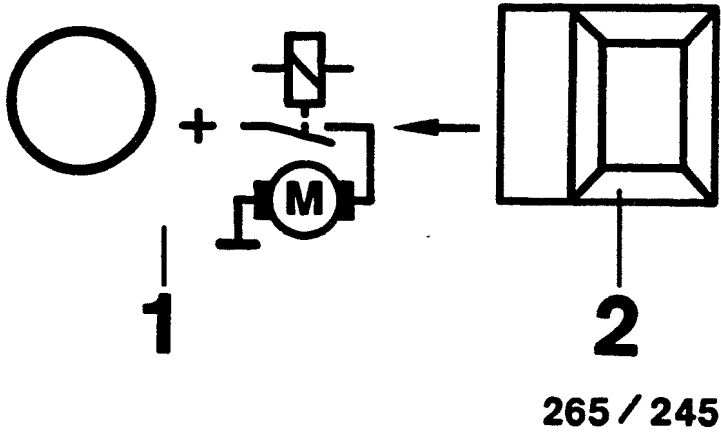


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RAPID DIAGNOSIS CHART (CONTINUED)

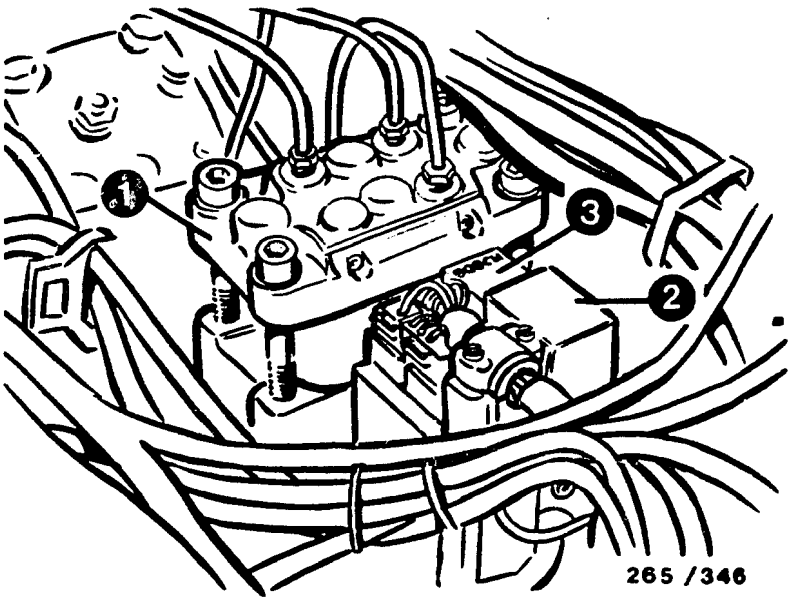
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 2.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



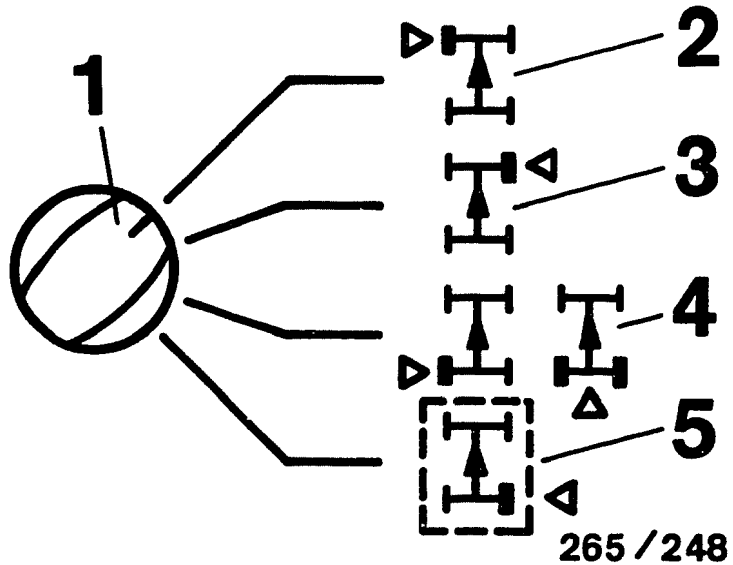
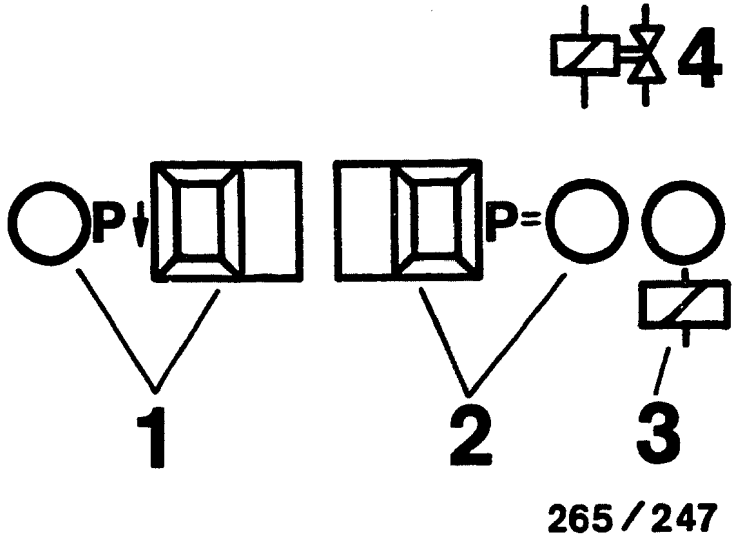
Program-selector-switch position 4 not applicable.

- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)  
 Program-selector-switch position 5 (3-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in line from valve relay term. 87 to batt. +ve  * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18  * Hydraulic modulator defective
	5.Release push-button P arrow (upper illustration)	LED P arrow (upper illus-tration) goes out, wheel locks	
	6.Release brake pedal		

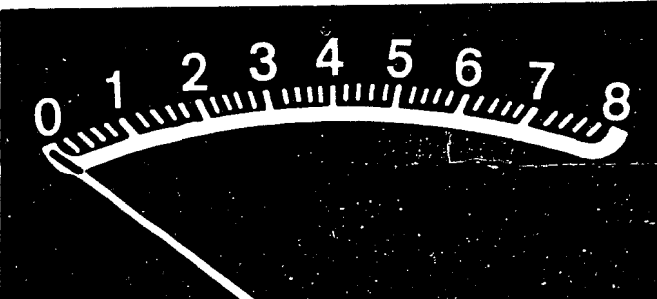
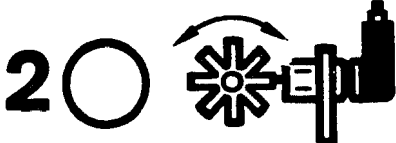


RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.6 and term.0,6...1,6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26)</p>	<p>Chock up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turnable by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1.Smallest reading larger 1,6 divisions</p> <p>2.Permissible fluctu- ation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Break in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math> Rear axle: 4 k <math>\Omega</math></p> <p>*Air gap between wheel-speed sensor and ring gear too wide</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading appears, LED 2 does not light up: loose contact in wheel- speed-sensor lead.</p>

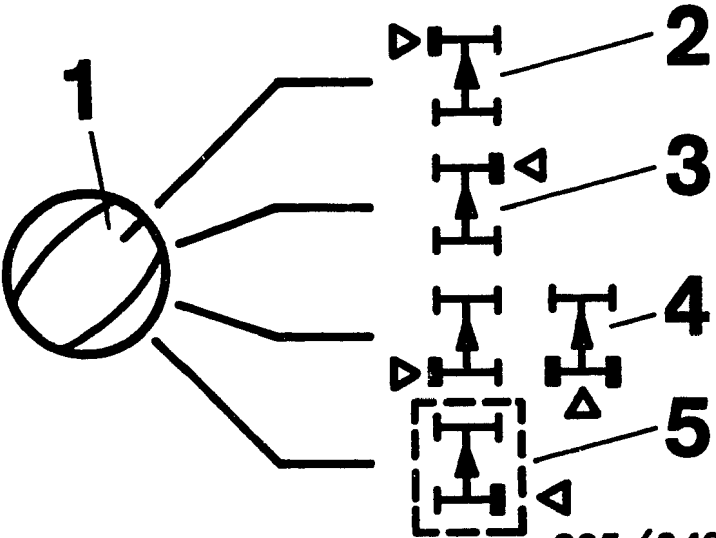
Continue test with next coordinate.



1

+

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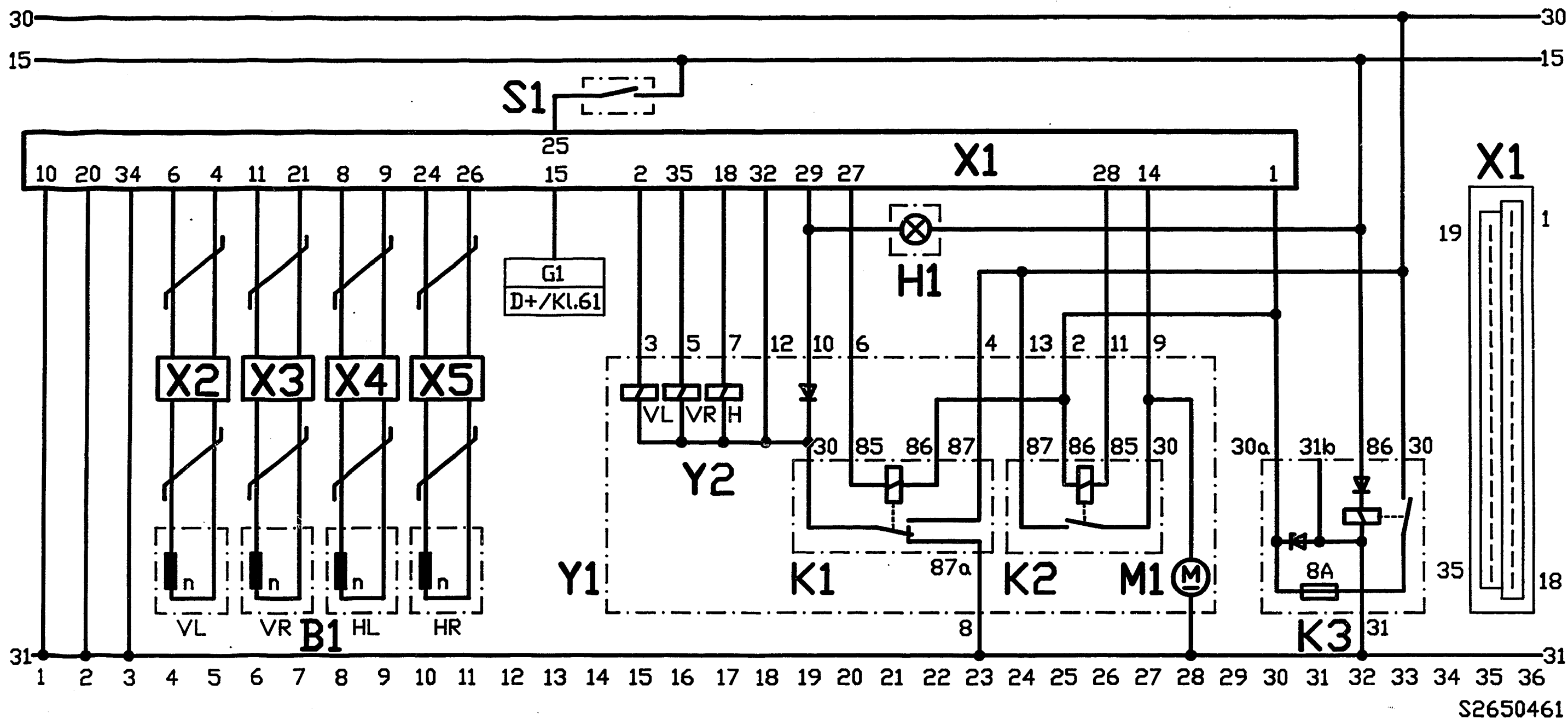
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TEST SPECIFICATIONS

Wheel-speed sensor		
* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:	600...1600	Ω
rear axle:	600...1600	Ω
Hydraulic-modulator solenoid-operated valves		
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7	Ω
Air gap: wheel-speed sensors, front		
wheel-speed sensors, rear	0,2...1,2 mm	0,5...1,5 mm
Tightening torque for		
* Fastening screws of the wheel-speed sensors:	> 8	Nm
* Brake-line connections on the hydraulic modulator:	12...16	Nm
Number of teeth		
* Front axle:	48	teeth
* Rear axle:	48	teeth

For production reasons:  
continued on the following  
coordinate.



B1 = Wheel-speed sensor  
 G1 = to alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Over-voltage protection relay

M1 = Return-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 H = Rear axle  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM

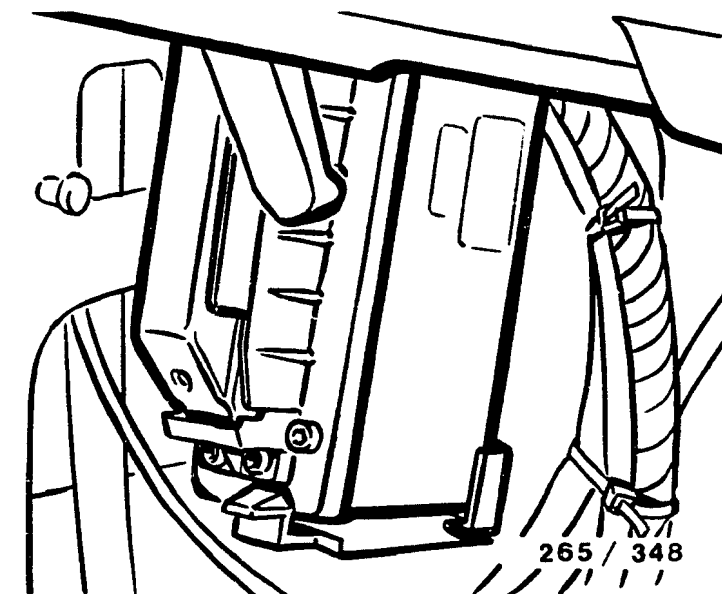
N19

N20

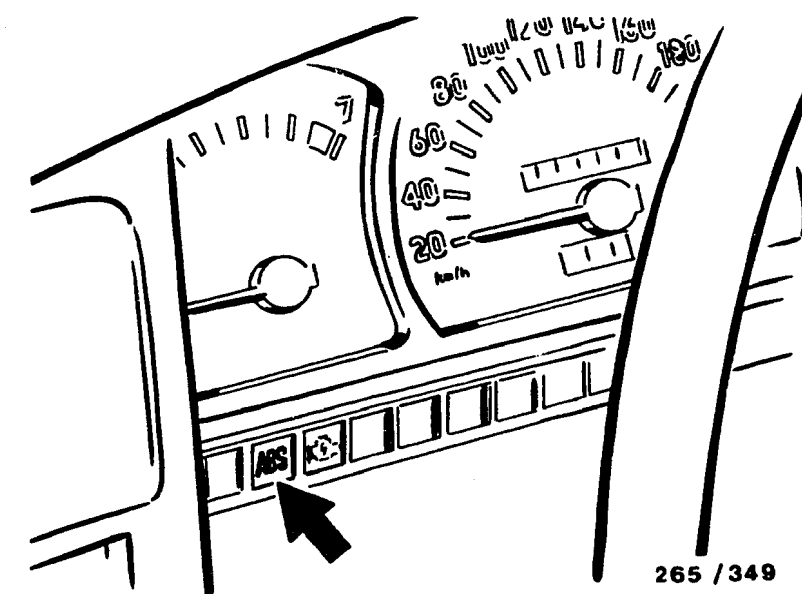
## INSTALLATION POSITION OF COMPONENTS

The stated installation locations are always referenced to the direction of travel.

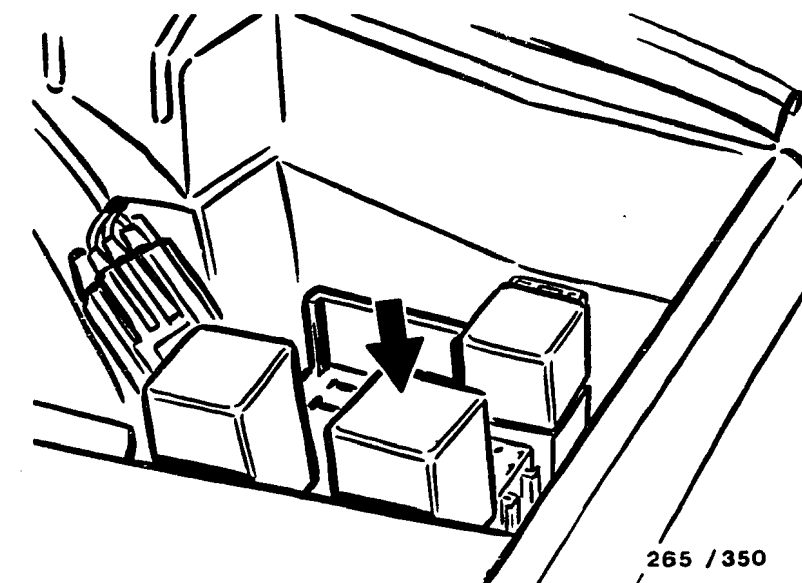
- \* Controller: top picture  
In driver's footwell on left-hand outer side.



- \* ABS warning lamp: center picture  
In instrument panel in indicator-lamp strip; 3rd lamp from left.



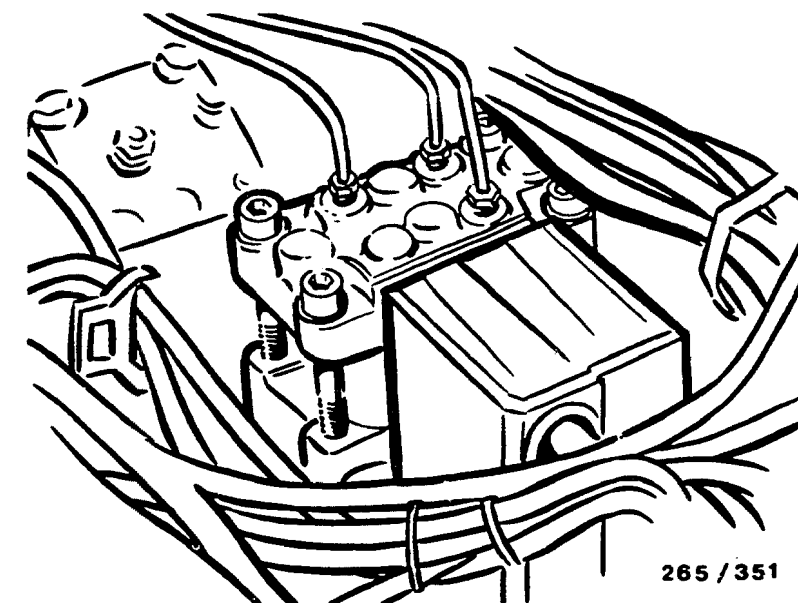
- \* Over-voltage protection relay: bottom picture  
In engine compartment, on left next to bulkhead in relay holder (arrow).



## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

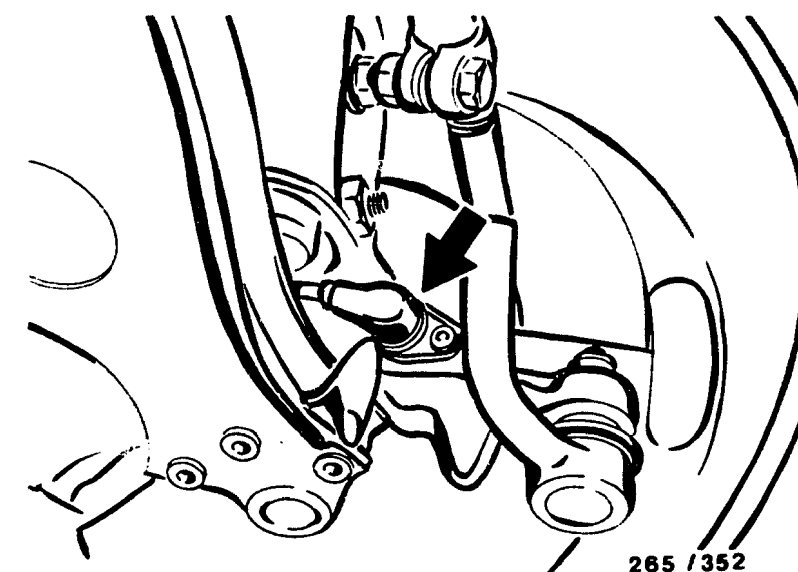
### \* Hydraulic modulator: top picture

In front left of engine compartment.



### \* Front-axle wheel-speed sensor: bottom picture

One each at either wheel in steering knuckles.  
Wheel-speed sensors cannot be adjusted.



## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

\* Rear-axle wheel-speed sensor: top picture

One each to left and right of differential.

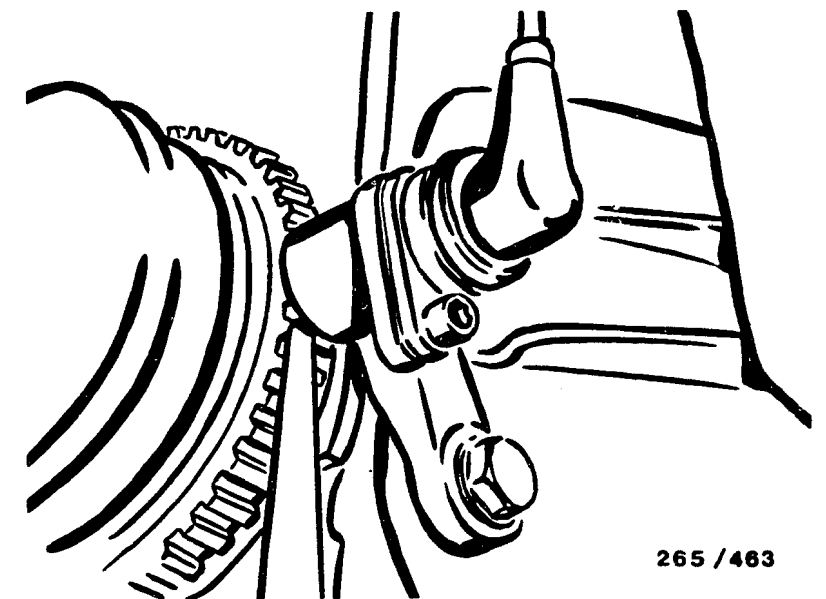
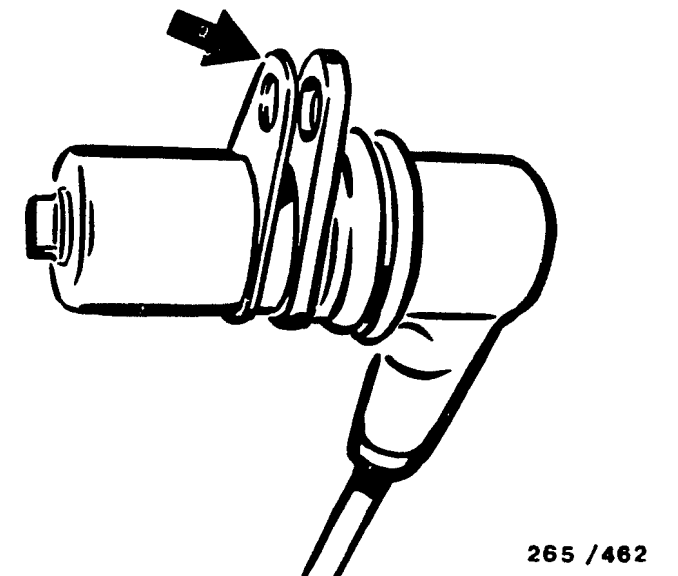
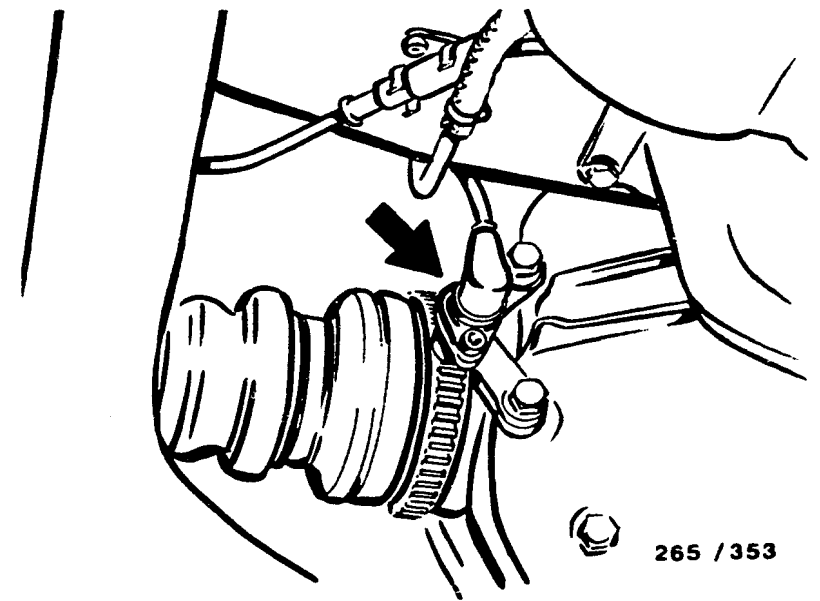
Center picture

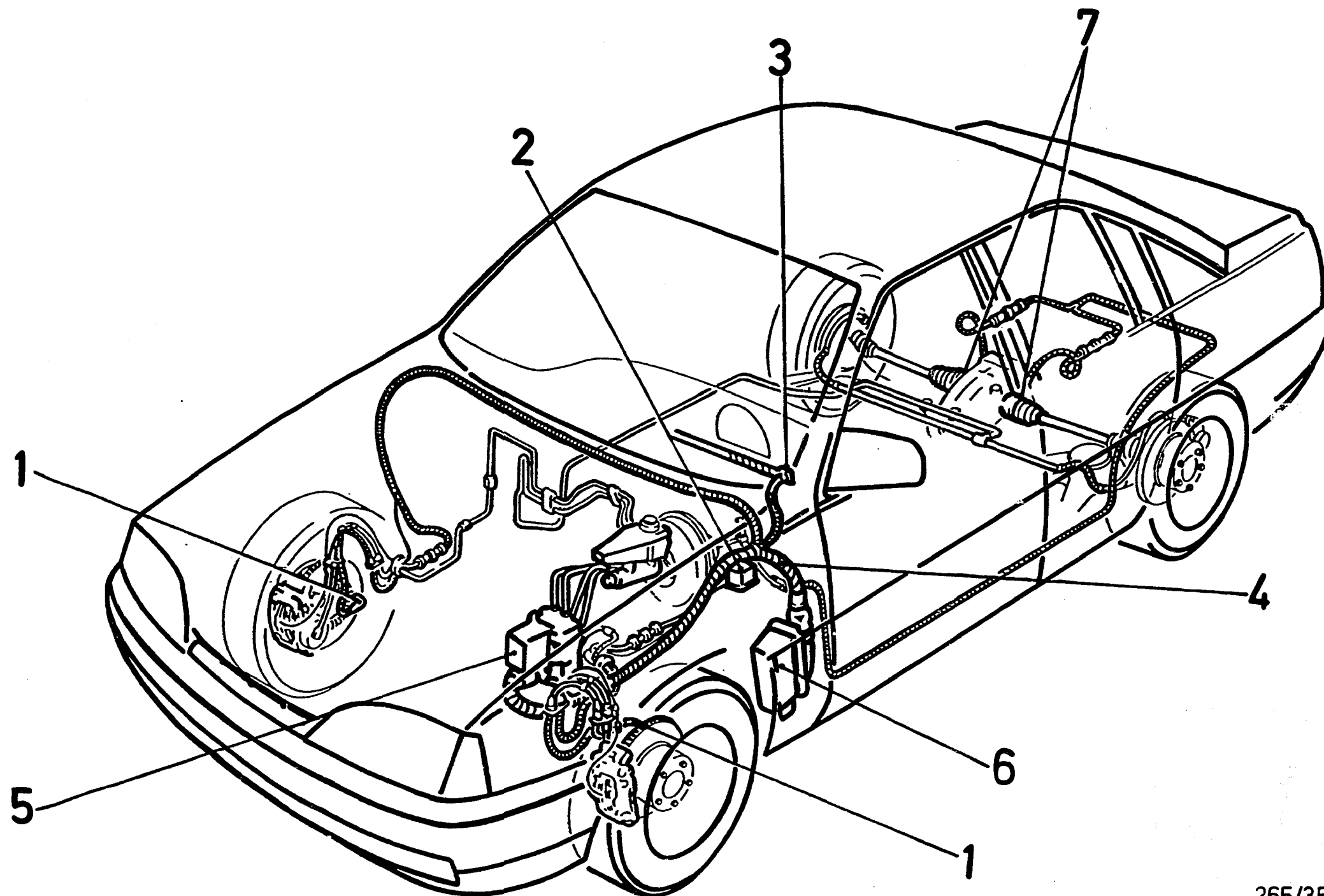
Important: pay attention to air gap when replacing wheel-speed sensors.

Air gap can be adjusted with washers (arrow).

Bottom picture

Measure air gap between ring gear and wheel-speed sensor with feeler gauge. Set air gap to between 0.5 and 1.5 mm.





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# INSTALLATION POSITION OF COMPONENTS (CONTINUED)

1 = Wheel-speed sensors, front axle  
 2 = Overvoltage-protection relay  
 3 = ABS - warning lamp  
 4 = ABS - wiring harness

5 = Hydraulic modulator  
 6 = ABS controller  
 7 = Wheel-speed sensors, rear axle